VR2250
Instruction Manual

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1. SAFETY PRECAUTIONS AND PROCEDURES

1.1. FORWARD

This instrument conforms with safety standards EN61557 and EN 61010-1 relating to electronic measuring instruments.

WARNING

For your own safety as well as that of the apparatus you are recommended to follow the procedures described in this instruction manual and carefully read all the notes preceded by the symbol⚠.

Strictly adhere to the following instructions before and during measurements:

- ☞ Do not take measurements in wet environments or dusty places.
- ☞ Do not take measurements in environments with explosive gas or fuels.
- ☞ Do not touch the wiring under test whilst taking measurements
- ☞ Avoid any contact with exposed metal parts, ends of test leads not in use, circuits, etc.
- ☞ Do not perform any measurement if the instrument is damaged, e.g, cracked case, leaking batteries, absence of display reading etc.
- ☞ Do not use the external power supply adapter (code MARVR2250PSU) if you notice deformation, or damage to the case, wire or to the plugs.
- ☞ Pay careful attention when measuring voltages exceeding 25V in places SUCH AS building yards, swimming pools, etc. and 50V elsewhere, because of the risk of electric shock.
- ☞ Use only cables and accessories approved by Martindale Electric.

The following symbols are used in this manual:

Caution: refer to the instructions in this manual, improper use may damage the apparatus or its components.

AC Voltage or Current.

Unidirectional pulsating Voltage or Current.

Rotary switch of the instrument.

1.2. PRELIMINARY INSTRUCTIONS

- ☞ This instrument has been designed for use in environments with a pollution level 2 and up to (and no more than) 2000 meters altitude.
- ☞ It can be used for Safety Test on Installation with Over voltage Category III 300V~ (phase to earth) and for **voltage and current** measurements on installations with over voltage category III 600 V~ phase to phase / 300 V~ phase to earth or CATII 350 V phase to earth.

- ☞ Please keep to the usual safety standards aimed at:
  - ♦ Protecting against dangerous currents;
  - ♦ Protecting the instrument against improper use.
- ☞ Only the accessories supplied with the instrument guarantee compliance with the safety standards. Accordingly, they must be in good condition and, if necessary, they must be replaced with identical models.
- ☞ Do not take measurements on circuits exceeding the specified current and voltage limits.
- ☞ Before connecting cables, croc clips and clamps to the circuit under test, make sure that the correct function has been selected.
- ☞ Do not take any measurements under environmental conditions beyond the limits specified in paragraph 13.4.
- ☞ Check that batteries are not weak and have been inserted correctly.
- ☞ Before connecting test leads to the circuit under test, check that rotary switch position is correct.
- ☞ Check that the LCD and the rotary switch indicate the same function.

1.3. DURING USE

Please read carefully the following recommendations and instructions:

WARNING

Non compliance with the warnings and / or instructions may damage the apparatus and / or its components, or injure the operator.

- ☞ Before selecting any function, disconnect the test leads from the circuit under test.
- ☞ When the instrument is connected to the circuit under test do not touch any unused test leads.
- ☞ Avoid taking resistance measurements in the presence of external voltages, even though the instrument is protected, too high a voltage may cause malfunctions.
- ☞ When measuring current, other currents near the test leads may affect the measuring accuracy.
- ☞ When measuring current, always position the wire in the middle of the current clamp jaws in order to obtain the highest accuracy.
- ☞ A measured value remains constant if the "HOLD" function is active. Should you notice that the measured value remains unchanged, disable the “HOLD” function.

WARNING

The symbol "▬" shows the battery status: When it is completely black the batteries are fully charged, while the "▭" symbol indicates weak batteries. When the batteries are too low to execute the test the instrument will show a warning message. In this case interrupt testing and replace batteries following the procedure described under paragraph 12.2. **The instrument is capable of keeping the data stored even though batteries are not installed. The Instrument Date and Time settings are not lost if you change the batteries within 24 hours.**

1.4. AFTER USE

- After use, turn off the instrument by pressing ON/OFF for a few seconds.
- Remove batteries when the apparatus remains unused for long periods. Please follow the storage instructions described at paragraph 13.4.

2. GENERAL DESCRIPTION

2.1. INTRODUCTION

The instrument you have just purchased will grant you accurate and reliable measurements provided that it is used according to these instructions.
The instrument was designed to grant the user the highest level of safety thanks to an innovative design assuring double insulation and over voltage category III.

2.2. FUNCTIONS

The instrument is able to perform the following tests:

- ☞ **LOWΩ**: Continuity Test of Earth, Protective and Equalising conductors with test current higher than 200mA and open circuit voltage ranging from 4V to 24V.
- ☞ **MΩ**: Measurement of insulation resistance with DC test voltage 50V, 100V, 250V, 500V or 1000V.
- ☞ **RCD**: Measurement on general and/or selective RCD's AC type (∿) and A type (⎍) of the following parameters:
  - ✓ Tripping time.
  - ✓ Tripping current.
  - ✓ Contact voltage (U_t).
  - ✓ Overall earth resistance (R_a).
    In this mode the instrument can measure the overall earth resistance without causing RCD tripping.
- ☞ **LOOP** ↻: ✓ Measurement of line and fault loop impedance with calculation of prospective short circuit current,
  - ✓ Measurement of fault loop impedance between phase and earth and
  - ✓ Global Earth resistance measurement without RCD tripping
  - ✓ Calculation of prospective short circuit current, indication of phase rotation sequence
- ☞ **EARTH** Measurement of Earth Resistance and Resistivity using earth rods.
- ☞ **AUX**: For future use
- ☞ **ANALYZER**: The instrument allows the following operations:
  - ✓ **Display in real time** the electrical parameters of single phase systems and the harmonic analysis of voltage and current.
  - ✓ **Conduct a direct Energy measurement** (without memorising).
  - ✓ **Memorise** (pressing SAVE key) the sampled values of the parameters present at instrument input generating an "Smp" record in instrument memory. **It will be possible to analyse the memorised data ONLY by transferring the data to a PC.**
  - ✓ **Record simultaneously** (pressing the START key after setting parameters): RMS values of voltage, current, corresponding harmonics, active, reactive and apparent powers, power factors and cosφ, active, reactive and apparent energies, voltage anomalies (voltage sag and surge) with 10ms resolution. **It will be possible to analyse the recorded data ONLY by transferring the data to a PC.**

WARNING

⚠ Please note the difference between **memorise** and **record**. These terms will be used repeatedly in this manual. Please focus on their definitions and distinctions.

3. PREPARATION FOR USE

3.1. INSPECTION

This instrument has been checked mechanically and electrically prior to shipment.
Every care has been taken to ensure that the instrument reaches you in perfect condition.

You are recommended, however, to check for any possible damage which might have been caused during transport. Should this be the case, immediately contact the distributor.

Check that the packaging contains all the parts listed under paragraph 13.5. In case of discrepancies contact the distributor.

In the unlikely event that you have to send the instrument back, please follow the instructions detailed in section 14.

3.2. POWER SUPPLY

The instrument can be powered by:

- ✓ 6 batteries 1.5V AA - LR6 series located in the compartment on the back of the instrument (not included in the package). For battery life see paragraph 13.3.1
- ✓ An external power supply adapter (code MARVR2250PSU) **to be used only for ANALYSIS and AUX function**. It is recommended that the MARVR2250PSU Power Supply adapter is used for long-term measuring.

WARNING

For your own safety it is not permitted to use the external power supply adapter during Safety Test (LOWΩ, MΩ, RCD, LOOP, EARTH rotary switch positions). If you press the START button the Instrument will show the message "⚠ REMOVE POWER".

The symbol ▬ shows the battery status: If it is completely "black" the batteries are fully charged, while the ▭ symbol indicates weak batteries. When the batteries are too low to execute the test the instrument will show a warning message.
In this case interrupt testing and replace batteries following the procedure described under paragraph 12.2.

The instrument is capable of keeping the data stored even though batteries are not installed. The instrument Date and Time settings are not lost if you change the batteries within 24 hours.

WARNING

For recordings (ANALYSIS and AUX function) it is recommended to ALWAYS use the external power supply adapter (code MARVR2250PSU), although the instrument does allow the operator to perform a recording using internal batteries. If during a recording the external power supply adapter is de-energised, the instrument will continue the recording using the internal battery power until the batteries are exhausted (the data stored up to the point the instrument shuts down will be saved). It is recommended to **ALWAYS insert a new set of batteries before a long recording.**

The instrument uses sophisticated algorithms to prolong the battery life. Particularly:

- ✓ The instrument switches OFF the backlight automatically after 5 seconds.
- ✓ If the instrument is displaying in real time (and the external power supply adapter is not connected), after about 5 minutes from the last key press or switch rotation the instrument turns off automatically ("AUTOPOWER OFF" feature).
- ✓ If the instrument is recording or is measuring energy (and the external power supply is not connected), after about 5 minutes from the last key pressure or switch rotation the instrument starts a special procedure to save the batteries ("ECONOMY MODE"): the instrument keeps recording but the display is turned off.

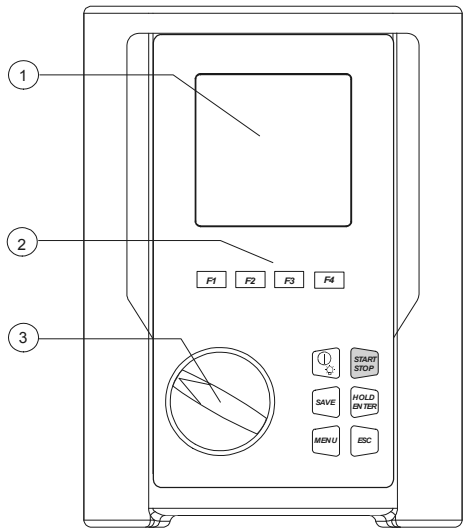
3.3. CALIBRATION

The instrument fulfils the technical specifications listed in this manual. The performance of the specifications is guaranteed for one year.
Annual calibration is recommended.
Please call 01923 441717 for details.

3.4. STORAGE

In order to ensure the accuracy of the measurements, after a period of storage in extreme environmental conditions, wait until the apparatus is back to normal measuring conditions (see environmental specifications listed in paragraph 13.4).

4. INSTRUMENT DESCRIPTION



LEGEND:

1. **Display**
2. **Function Keys**
3. **Rotary switch**

F1 **F2** **F3** **F4** ☞ Multifunction Keys.

ON/OFF ☞ **ON/OFF** and backlight key. Press for a few seconds to switch ON the instrument, press it briefly to activate the backlight function.

START STOP ☞ This key is used to start and stop the measurement.

SAVE ☞ This key allows you to save the result displayed.

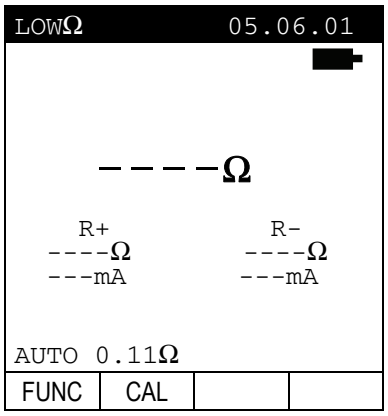
HOLD ENTER ☞ This key has a double function. It is the confirmation key for the configuration menu and it allows you to freeze the displayed results using the ANALYZER function.

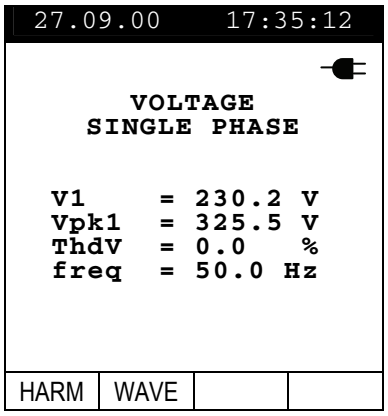
MENU ☞ This key opens the General Configuration Menu.

ESC ☞ This key allows you to quit the configuration menu or the selected working mode.

4.1. DISPLAY DESCRIPTION

The display is a graphic module with a resolution of 128 x 128 pixels
The first line of the display shows the function selected and the date and time. If not correct, these can be set according to the procedure described at paragraph 5.2.
On the top right corner of the display you can always see the battery indicator and, if the external power supply adapter (code MARVR2250PSU) is connected, the corresponding symbol is displayed.

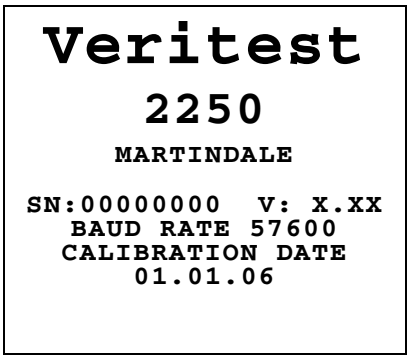




These symbols will be omitted in the following illustrations.

4.2. INITIAL SCREEN

When turning on the instrument by pressing ON/OFF, this screen will appear for a few seconds:



Here you can see:

- Serial number of the instrument (SN :)
- Firmware software release (V.X.XX :)
- Transmission speed through serial RS232 (Baud Rate)
- Calibration date (CALIBRATION :)

4.3. BACKLIGHT FUNCTION

When instrument is turned on, briefly pressing the **ON** button will enable the backlight. The light will be turned off automatically after 5 seconds.
If the batteries are too low the instrument will automatically disable the backlight function.

5. INITIAL SETTINGS

On pressing the **MENU** key the following screen will be displayed:

It is not possible to enter the **MENU** during a recording or a Real Time Energy measurement. Pressing this button during a recording will display the main recording parameters (see paragraph 9.3.1)

5.1. HOW TO ADJUST THE CONTRAST

By pressing the multifunction keys **F1** and **F2**, position the cursor on the **CONTRAST** item and confirm by pressing the **ENTER** key.
By pressing the multifunction keys **F3** and **F4**, adjust the contrast (higher values correspond to a higher contrast while lower values correspond to a lower contrast) and press the **ENTER** key to **SAVE** the change or press **ESC** to quit without saving.
This setting will remain unchanged after turning off the instrument.

5.2. HOW TO SET DATE AND TIME

By pressing the multifunction keys **F1** and **F2**, position the cursor on the **DATE & TIME** item and confirm it by pressing the **ENTER** key.

The time is expressed as **hh:mm** (2 digits for hours, 2 digits for minutes) 24 hour clock.
Press the **ENTER** key to **SAVE** the change or press **ESC** to quit without saving.
This setting will remain unchanged also after turning off the instrument.

5.3. HOW TO SET THE LANGUAGE

By pressing the multifunction keys **F1** and **F2**, position the cursor on the desired language and press the **ENTER** key to SAVE the change or press **ESC** to quit without saving.
This setting will remain unchanged after turning off the instrument.

5.4. RESET

This option re-establishes the initial settings of the instrument in **ANALYZER** function.

The “Current Range” parameter is not modified by the reset command.

The initial settings of the instrument consist of:

✓ ANALYZER CONFIG:

System:	SINGLE
Frequency:	50Hz
Current range:	not modified
Clamp type:	STD
Transforming ratio of voltage transformers:	0001
Password:	OFF

✓ RECORDER CONFIG:

Start:	MANU (the recording is started at 00 sec mark on clock after pressing the START/STOP key)
Stop:	MAN
Integration period:	15min
Recording of harmonics:	ON
Recording of Voltage anomalies (Sag and Surge):	ON
Voltage Reference for Sag and Surge detection:	230V
Upper Limit for Sag and Surge detection:	6%
Lower Limit for Sag and Surge detection:	10%
Selected voltages:	V1
Selected voltage harmonics:	THD, 01, 03, 05, 07
Selected currents:	I1
Selected current harmonics:	THD, 01, 03, 05, 07
CO-GENERATION:	OFF
Powers, Pf and cosφ selected:	P1
	Q1i
	Q1c
	S1
	Pf1
	DPf1
Energies:	Ea1
	Eri1
	Erc1
	Es1

The RESET command <u>will not</u> erase the instrument’s memory.

6. SAFETY TEST FUNCTIONS

6.1. LOWΩ: CONTINUITY TEST WITH 200mA TEST CURRENT

The measurement is performed according to EN 61557-2 and VDE 0413 part 4.

WARNING

Before carrying out the continuity test make sure that there is no voltage at the ends of the conductor under test.

Turn the **switch** to the **LOW Ω** position.

F1 This key permits you to select one of the following measuring modes:

- ☞ Mode "**AUTO**" (the instrument carries out two measurements with reversed polarity and displays their average value). This mode is recommended for the continuity test.
- ☞ Mode "**RT+**" (measurement with positive polarity and adjustable test time). The operator can set a measuring time long enough to permit him to move the protective conductors while the instrument is carrying out the test, enabling detection of any bad connections.
- ☞ Mode "**RT-**" (measurement with negative polarity and adjustable test time). The operator can set a measuring time long enough to permit him to move the protective conductors while the instrument is carrying out the test, enabling detection of any bad connections.

F2 This key executes the "**CAL**" mode (compensation of the resistance of the test leads used for the measurement).

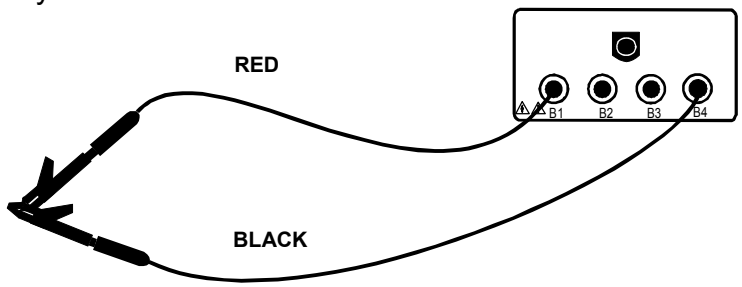
WARNING

If the resistance is lower than 5Ω (including the resistance of the test leads) the continuity test is conducted with a test current higher than 200mA. If the resistance is higher than 5Ω the continuity test is conducted with a current lower than 200mA.

We recommend that you check the calibration of the test leads before executing a measurement, according to the next paragraph (6.1.1).

6.1.1. Calibrating the test leads ("CAL" Mode)

1. Connect the Red and Black test leads to **B1** and **B4** input terminals respectively.



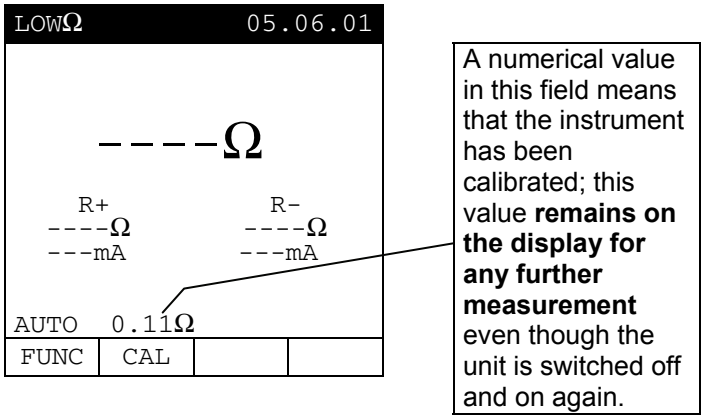
Connection of the test leads during calibration procedure.

2. Short-circuit the measuring cable ends making sure that the conductive parts of the croc clips make a good contact to each other (see previous picture).
3. Press the **F2** key. The instrument carries out the calibration.

F2

WARNING

Never disconnect the test leads when the message **"MEASURING"** is displayed.



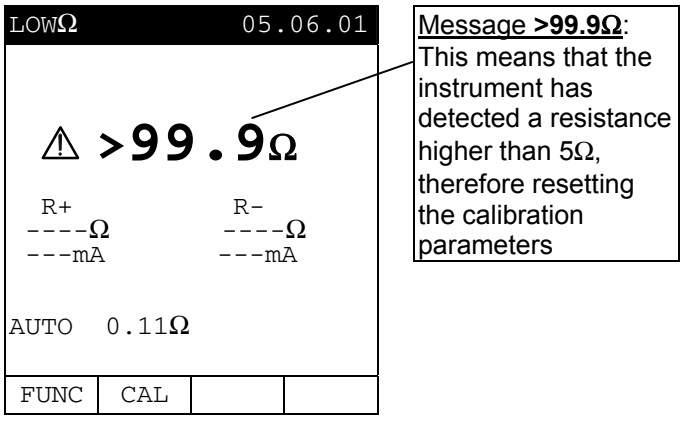
4. At the end of the test, the result is stored and used as an **OFFSET (that is to say that it is subtracted from any continuity test carried out)** for all the subsequent measurements.

Note: The instrument performs the calibration only if the resistance of the test leads is lower than **5Ω**.

TEST LEADS Before each measurement always make sure that the calibration is applicable to the test leads in use. During a continuity test, if the resistance value free of calibration (that is the resistance value is less than the calibration offset value) is **negative**, the symbol ⚠ is displayed. The calibration resistance value stored in the instrument memory is not applicable to the test leads in use; therefore a new calibration must be performed.

6.1.1.1. Procedure to reset test leads calibration parameters

☞ To remove a stored calibration you must perform the calibration procedure with a resistance higher than 5Ω (for example, with disconnnected test leads

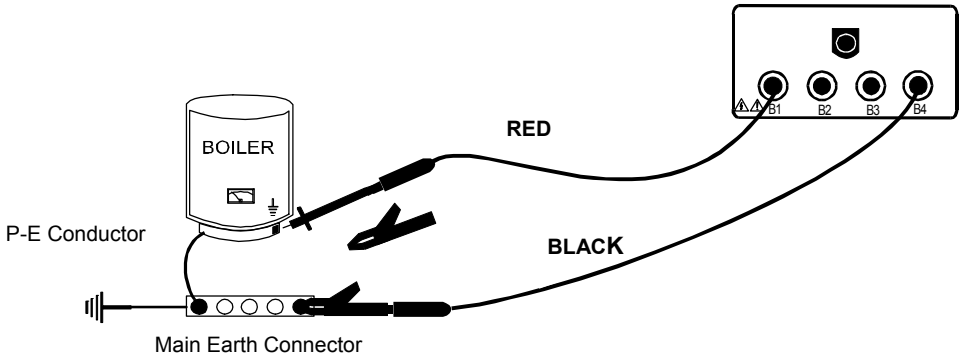


Message **>99.9Ω**:
This means that the instrument has detected a resistance higher than 5Ω, therefore resetting the calibration parameters

6.1.2. Measurement Procedure

F1

1. Select the desired mode by means of the **F1** key.
2. Connect the Red and Black test leads to **B1** and **B4** input terminals respectively



Connection of the test leads during LOW Ω test.

3. If the cables supplied with the instrument are not long enough for the measurement you may extend the black cable.
4. Short-circuit the test leads making sure that the conductive parts of the croc clips make a good contact with each other. Press the START key. **If the display does not show 0.00Ω, repeat the test lead calibration** (see paragraph 6.1.1).
5. Connect the instrument terminals to the ends of the conductor under test (see previous picture).

F3
F4

6. **If the mode "RT+" or "RT-"** was selected use the **F3**, **F4** keys to set the duration of the test.

START STOP

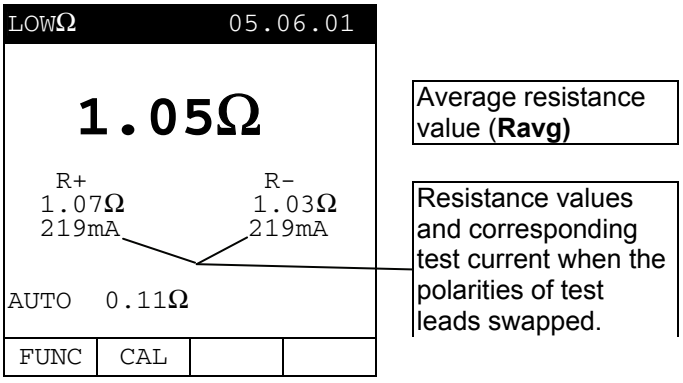
7. Press the **START** key. The instrument will execute the measurement. In RT+/RT- (Timer mode) you can press START key again if you want to stop the test before the duration set has expired.

WARNING

Never disconnect the test leads when the message **"MEASURING"** is displayed.

6.1.3. Results of "AUTO" mode

☞ At the end of the test, if the **average resistance value <u>Ravg</u> is <u>lower than 5Ω,</u>** the instrument emits a **double sound signal** indicating the **positive outcome of the test** and displays a screen similar to this.

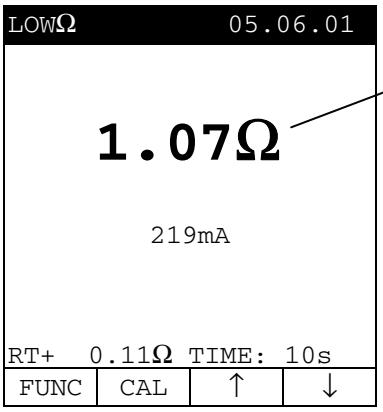


SAVE

The displayed result can be stored pressing the **SAVE** key **twice** (see paragraph 8.1).

6.1.4. Results of "RT+" and "RT-" modes

☞ If the **resistance value of RT+** or **RT+ is lower than 5Ω**, the instrument emits a **double sound signal indicating the positive outcome** of the test and displays a screen similar this.

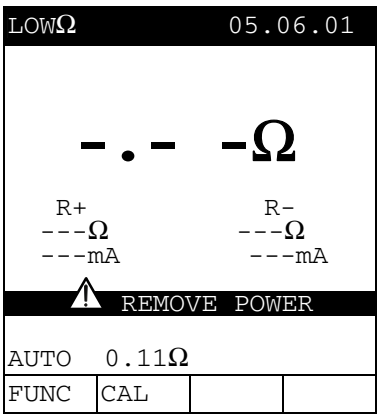


Note: We recommend that crocodile clips are used to achieve a good contact with the conductor under test. In this test the instrument gives as a final result the maximum measured value of R+ or R-, and using test leads instead of crocodile clips could give an incorrect result due to bad contact between the test leads and conductor under test.

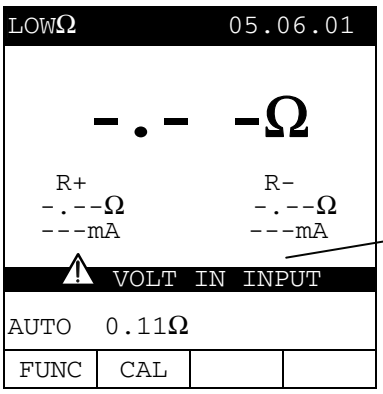
SAVE The displayed result can be stored pressing the **SAVE** key **twice** (see paragraph 8.1).

6.1.5. "AUTO", RT+", "RT-" faulty cases

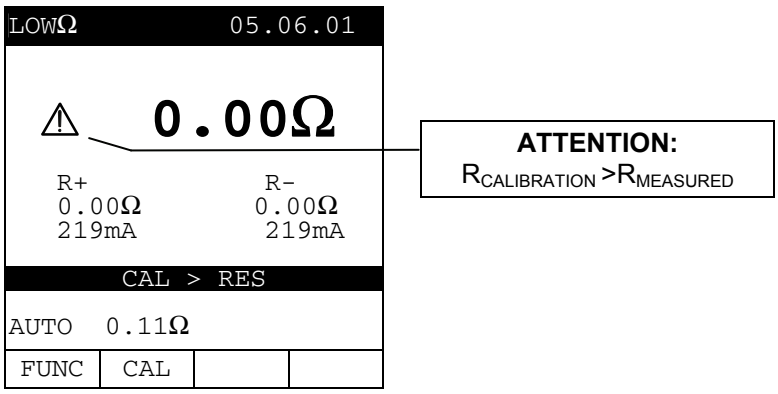
☞ If the instrument detects the external power supply adapter connected the instrument will display a screen similar to this



☞ If the terminal voltage is higher than 15V, the instrument does not carry out the test, and displays a screen similar to this for 5 seconds.

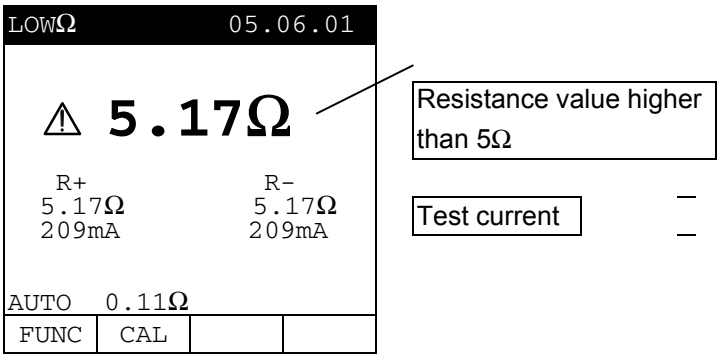


☞ In case that: **$R_{CALIBRATION} > R_{MEASURED}$** the instrument displays the screen alongside.



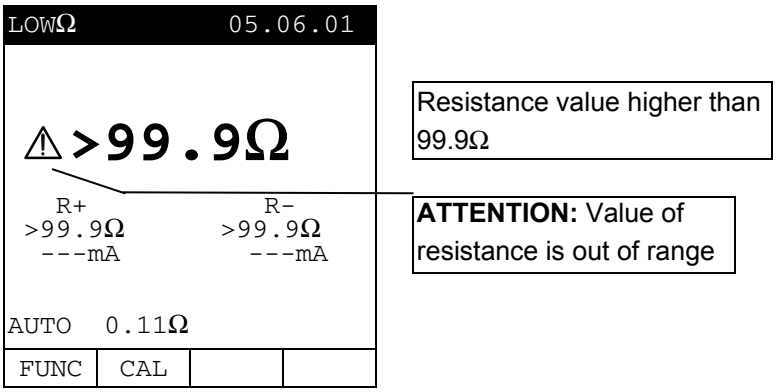
<u>THE PREVIOUS RESULTS CANNOT BE SAVED</u>.

☞ If the value of **<u>resistance is higher than 5Ω</u>** (but lower than 99.9Ω) the instrument **emits a long sound signal** and displays a screen similar to this.



SAVE The displayed result can be stored pressing the **SAVE** key **twice** (see paragraph 8.1).

☞ If the value of the **<u>resistance is higher than 99.9Ω</u>** the instrument emits **a long sound signal** and displays a screen similar to this.



SAVE The displayed result can be stored pressing the **SAVE** key **twice** (see paragraph 8.1).

6.2. MΩ: INSULATION RESISTANCE MEASUREMENT WITH 50V, 100V, 250V, 500V, 1000V TEST VOLTAGE

These measurements comply with IEC 61557-2 and VDE 0413 part 1.

WARNING

Before carrying out the insulation test, make sure that the circuit under test is not energised and all the loads are disconnected.

Turn the **switch** to the **MΩ** position.

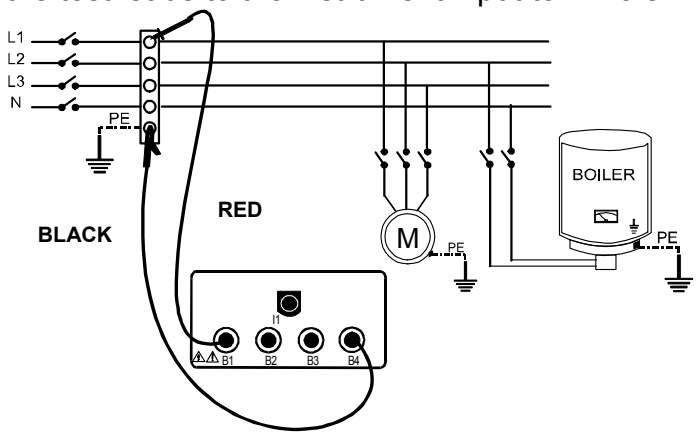
F1 The key **F1** selects one of the following measuring modes:

- ☞ Mode "**MAN**" (Manual mode). Minimum test time of 5 secs, or for as long as the start key is pressed. This is the recommended test.
- ☞ Mode "**TMR**" (Timer mode: test duration depends on the selected interval from 10 to 999 seconds). This test can be used if a minimum measuring time is required.

6.2.1. Measurement Procedure

F1 1. Select the desired mode by means of the **F1** key.

2. Connect the test leads to the instrument input terminals **B1** and **B4** respectively,



Example: insulation measurement between phase L1 and earth in a 3 PHASE electrical installation using test leads.

3. If the cables supplied with the instrument are not long enough for the measurement you may extend the black cable.
4. Connect the instrument terminals to the object which is to be submitted to the insulation test **after de-energizing the circuit under test and all loads** (see above).

F2 5. By using **F2,** select the test voltage suitable for the type of test to be carried out (see Table 1). The values that can be selected are:

- 50V (test on telecommunication system)
- 100V
- 250V
- 500V
- 1000V

Standard	Brief description	Test voltage	Maximum limit value
CEI 64-8/6	Systems SELV or PELV Systems up to 500V Systems over 500V	250VDC 500VDC 1000VDC	> 0.250MΩ > 0.500MΩ > 1.0MΩ
CEI 64-8/4	Floor and wall insulation Floor and wall insulation in systems over 500V	500VDC 1000VDC	> 50kΩ (se V<500V) > 100kΩ (se V>500V)
EN60439	Electrical panel boards 230/400V	500VDC	> 230kΩ
EN60204	Electrical equipment of machines	500VDC	> 1MΩ

Table 1: Table for test voltages and the corresponding limit values for reference.

Rated voltage selected for the test	R_{MAX} = Maximum resistance value
50VDC	99.9MΩ
100VDC	199.9MΩ
250VDC	499MΩ
500VDC	999MΩ
1000VDC	1999MΩ

Table 2: Table of maximum resistance values which can be measured in MΩ mode depending on the rated voltage selected.

F3
F4

6. If the **"TMR"** mode was selected, use the **F3** and **F4** keys to set the duration of the test:

WARNING

Never disconnect the test leads from the circuit under test when the message **"MEASURING"** is displayed, as the circuit under test may remain charged at a dangerous voltage. The instrument has an internal "safety resistor" which is connected to the output terminals before the end of the test in order to remove any stored charge in the installation

START STOP

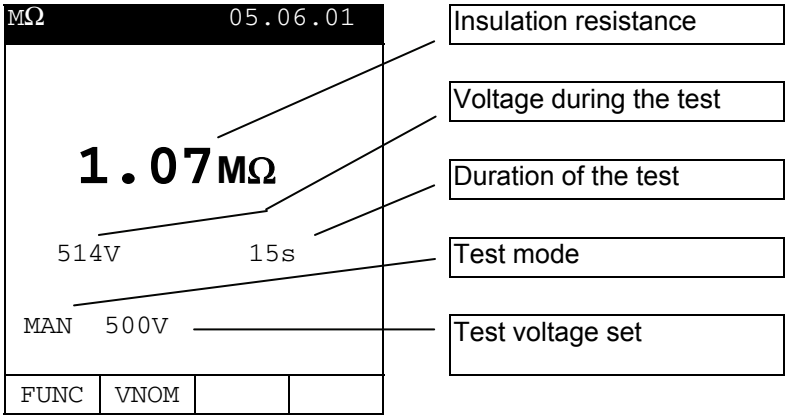
7. Press the **START** key.

The instrument will start the test.

- ✓ MAN Mode: The test will take 5 seconds (maximum). If the START key pressed longer than 5 seconds, the test continues until the key is released.
- ✓ TMR mode: The test will take the time set. If you want to stop the test press the START STOP key again.

6.2.2. Results of "MAN" mode

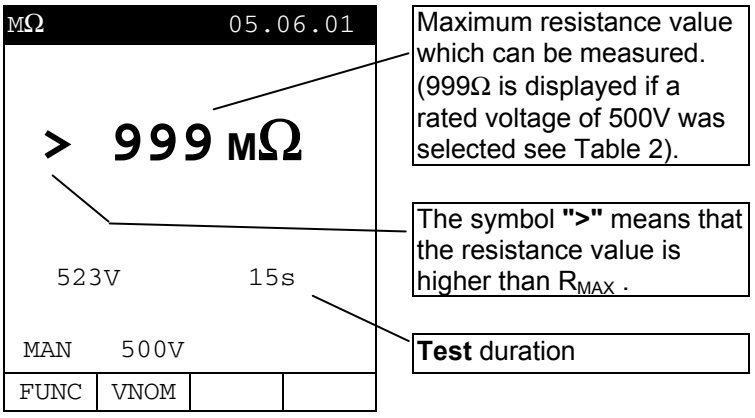
☞ At the end of the test if the insulation resistance is **lower than R_{MAX}** (see **Table 2**) **and the instrument generated the nominal test voltage**, the instrument emits a **double sound signal indicating the positive outcome of the test** and displays a screen similar to this



In order to evaluate the test you must compare the result with the limits indicated in the guidelines (see Table 1 1).

SAVE The displayed result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

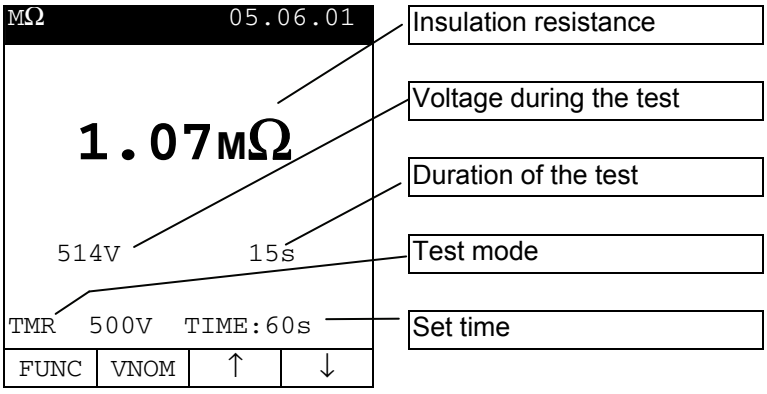
☞ If the Insulation resistance is **higher than R_{MAX}** (see **Table 2**) the instrument emits a **double sound signal indicating the positive outcome of the test** and displays a screen similar to this.


MΩ
05.06.01
> 999 MΩ
523V
15s
MAN 500V
FUNC
VNOM
Maximum resistance value which can be measured. (999Ω is displayed if a rated voltage of 500V was selected see Table 2).
The symbol ">" means that the resistance value is higher than R_{MAX} .
Test duration

SAVE The displayed result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

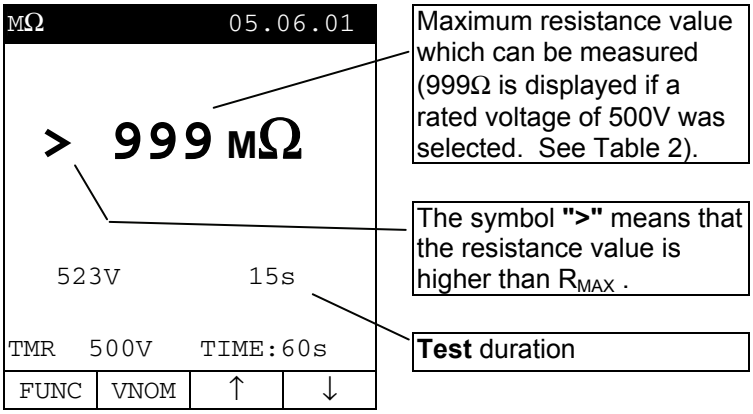
6.2.3. Results of "TMR" mode

☞ If the insulation resistance is **lower than R_{MAX}** (see **Table 2) and the instrument generated the nominal test voltage**, the instrument emits a **double sound signal indicating the positive outcome of the test** and displays a screen similar to this.



SAVE The displayed result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

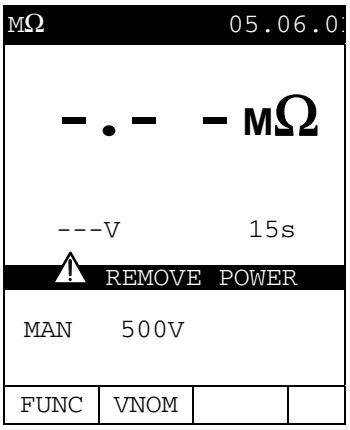
☞ If the Insulation resistance is **<u>higher than R_{MAX}</u>** (see **Table 2**) the instrument emits a **double sound signal** at the end of the test **indicating the positive outcome of the test** and displays a screen similar to this.



SAVE The displayed result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

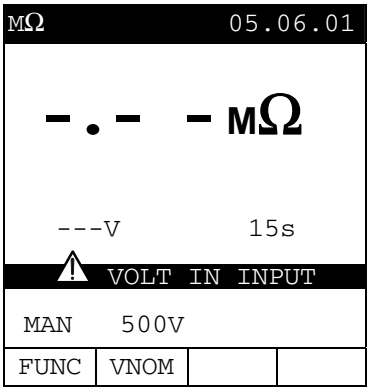
6.2.4. "MAN" and "TIMER" mode faulty cases

☞ If the instrument detects the external power supply adapter connected, it displays a screen similar to this.



Disconnect the external power supply adapter

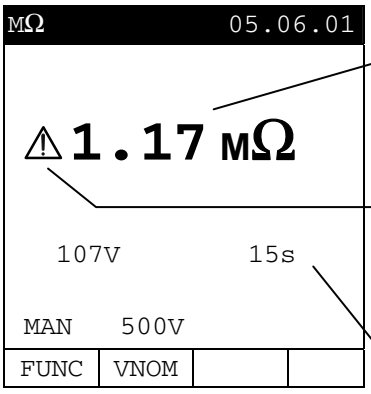
☞ If the instrument detects a voltage between the input terminals higher than 15V, the instrument does not perform the test and displays this screen for 5 seconds.



ATTENTION: the test cannot be executed. Check that the circuit is not energised.

These results cannot be saved

☞ If the instrument cannot generate the nominal test voltage, it will emit a **long sound signal** and display a screen similar to this.



Insulation Resistance

ATTENTION: the test of resistance R_{ISO} **was performed at a voltage value lower than the set rated voltage**. Low insulation case. This occurs under low insulation conditions or in the presence of capacitance on the installation.

Test Time

SAVE The displayed result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

6.3. RCD: TEST ON "A" AND "AC" TYPE RCDs

The test is executed according to IEC61557-6, EN61008, EN61009, EN60947-2 B 4.2.4 and VDE 0413 part 6.

WARNING

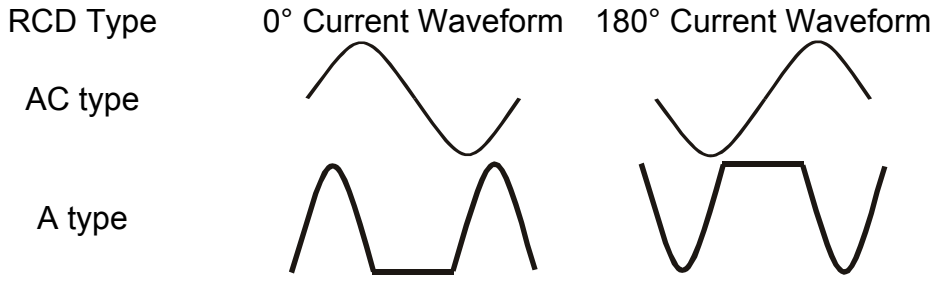
The automatic check of the RCD causes tripping of the RCD itself. Therefore **check that all devices connected downstream of the RCD under test are not damaged by power off.** It is advisable to disconnect all the loads connected downstream of the RCD, as they could add leakage currents to the result, so making the test results void.

Turn the **switch** to the **RCD** position:

F1 The **F1** key selects one of the following measuring modes (which can be shown cyclically when pressing the key):

- Mode "**AUTO**" (the instrument performs the test automatically with a leakage current equal to half, once and five times the value of the rated current set). Recommended test.
- Mode "**x ½**" (the instrument performs the test with a leakage current equal to half the value of the rated current set).
- Mode "**x 1**" (the instrument performs the test with a leakage current equal to the value of the rated current set).
- Mode "**x 2**" (the instrument performs the test with a leakage current equal to twice the value of the rated current set).
- Mode "**x 5**" (the instrument performs the test with a leakage current equal to five times the value of the rated current)
- Mode "**⟋**" (the instrument performs the test with a steadily increasing leakage current. Use this test to measure the tripping current).
- Mode "**R_A⏚**" (the instrument performs the test with a leakage current equal to half the value of the selected rated current and calculates the contact voltage as well as the R_a earth resistance).

N.B. The **AUTO** mode executes the test automatically with phase 0° and 180°



According to standard practice it is recommended to perform the RCD test both with phase 0° and with phase 180° even with non AUTO modes. If the RCD under test is type A (which means sensitive to both AC and undirectional pulsing leakage currents) it is advisable to perform the test both with sine wave and undirectional pulse current with phase 0° and 180°.

F2 The **F2** key selects one of the following rated tripping currents of the RCD (which can be shown cyclically when pressing the key):

- 10mA.
- 30mA.
- 100mA.
- 300mA.
- 500mA.

F3 The **F3** key permits to select the RCD type (which can be shown cyclically when pressing the key):

- "~": general RCD AC type (sensitive to sine leakage current)
- "⎍": general RCD A type (sensitive to pulsating leakage current)
- "~ **S**": selective RCD AC type (sensitive to sine leakage current)
- "⎍**S**":selective RCD A type (sensitive to pulsating leakage current)

Note if the test is performed on **general RCDs** the symbol “S” is NOT displayed

Note according to EN61008 the test on selective RCDs requires an interval between the tests of 60 seconds (30 seconds in case of tests at ½ $I_{\Delta n}$). A timer is displayed indicating the waiting time for each step.

Example: Test with AUTO mode on a RCD with $I_{\Delta n}$=30mA.

a) The instrument performs the test at ½ $I_{\Delta n}$ 0°. The RCD must not trip.
b) The instrument performs the test at ½ $I_{\Delta n}$ 180°. The RCD must not trip. For a selective RCD a 30 seconds timer starts before executing next test.
c) The instrument performs the test at $I_{\Delta n}$ 0°. If the RCD passed the test, it must trip and the instrument shows the message "RESUME RCD". The operator shall reset the RCD. For a Selective RCD a 60 seconds timer starts before executing the next test.
d) The instrument performs the test at $I_{\Delta n}$ 180°. Follow the same procedure as described under c).
e) The instrument performs the test at $5I_{\Delta n}$ 0°. Follow the same procedure as described under c).
f) The instrument performs the test at $5I_{\Delta n}$ 180°. Follow the same procedure as described under c). The test is completed.

F4 The F4 key selects one of the following **limit values for the contact voltage** (which can be shown cyclically when pressing the key):

- 50V (default)
- 25V.

WARNING

Never disconnect the test leads when the message **"MEASURING"** is displayed.

6.3.1. Tripping times for the general and selective RCDs

☞ **Table of tripping times for $I_{\Delta N}$ x1, $I_{\Delta N}$ x2, $I_{\Delta N}$ x5 and AUTO tests.**
If the parameters set on the instrument comply with the type of RCD under test (and if the latter works properly) the tests **x1**, **x2**, **and x5 SHALL** cause the RCD tripping within the times shown in the following table:

RCD type	$I_{\Delta N}$ x 1	$I_{\Delta N}$ x 2	$I_{\Delta N}$ x 5	Description
General	0.3s	0.15s	0.04s	**Max** tripping time in seconds
Selective S	0.5s	0.20s	0.15s	**Max** tripping time in seconds
	0.13s	0.05s	0.05s	**Minimum** tripping time in seconds

* For rated values IΔN ≥ 30mA the test current at five times is 0.25A.
For currents equal to ½ $I_{\Delta N}$ the RCD shall not trip in any case.

Table 3: Table of tripping times for tests with leakage currents $I_{\Delta N}$ x1, $I_{\Delta N}$ x2, $I_{\Delta N}$ x5 and AUTO.

Note:
The above values apply to RCD's manufactured to comply with BSEN61008. RCD's which are manufactured to comply with BS4293 are required to operate in 0.2s at IΔN x 1. It is important that the user of this instrument is aware of the applicable tripping time (s) for the RCD being tested.

☞ **Table of tripping times for ramp tests "⟋".**
The instrument generates a leakage current growing step by step in a given time interval.
The limit values for the tripping current are indicated in the following table:

RCD Type	$I_{\Delta N} \leq$ 10mA	$I_{\Delta N}$ > 10mA
A	1,4 x $I_{\Delta N}$	1,4 x $I_{\Delta N}$
AC	$I_{\Delta N}$	$I_{\Delta N}$

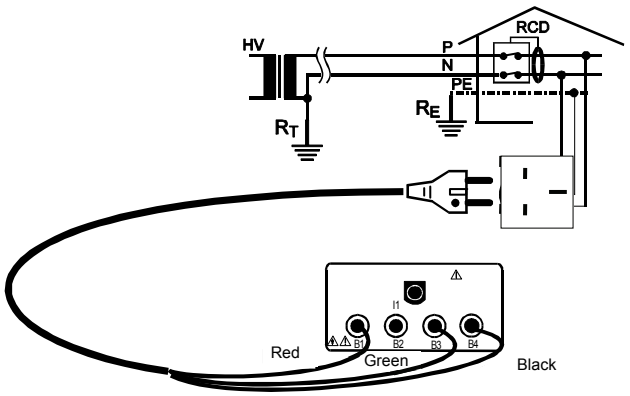
Table 4: Current limit value for "Ramp" Test

Note:
"**MAN**" **5 x IΔN** and "**AUTO**" test modes are not available for RCD type A at 500mA and are not required

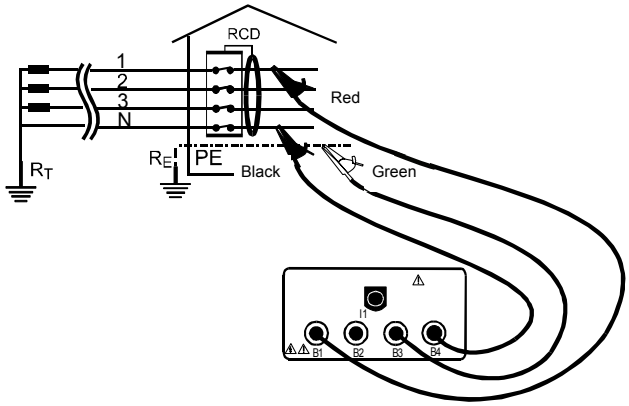
6.3.2. Measurement procedure

F1 F2 F3 F4 1. Select the desired test parameter with the **F1**, **F2**, **F3** and **F4** keys.

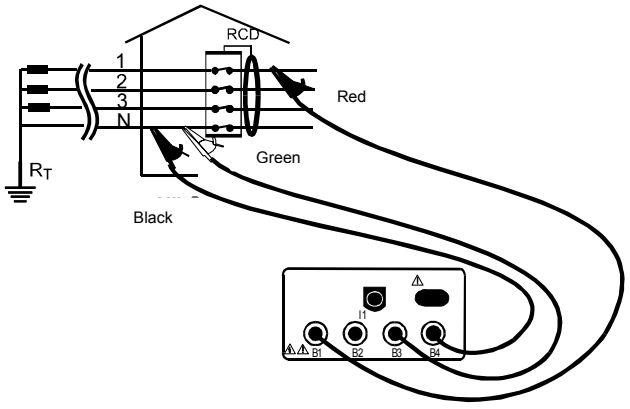
2. Connect the Red, Green and Black connectors of the three-terminal mains cable or of the split cables to the corresponding input terminals of the instrument **B1**, **B3**, **B4**



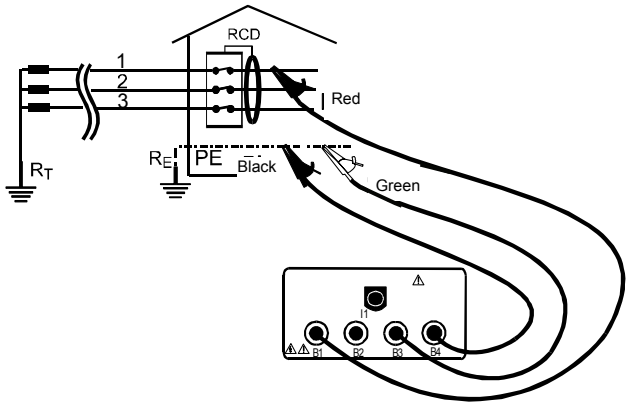
Instrument connection for 230V single-phase RCD check



Instrument connection for 400V + N + PE three-phase RCD check



Instrument connection for 400V + N (no PE) three-phase RCD check



Instrument connection for 400V + PE (no N) three-phase RCD check

3. Connect the mains plug or the test leads to the system under test according to one of the diagrams above.

6.3.2.1. Results of "*x½*" mode

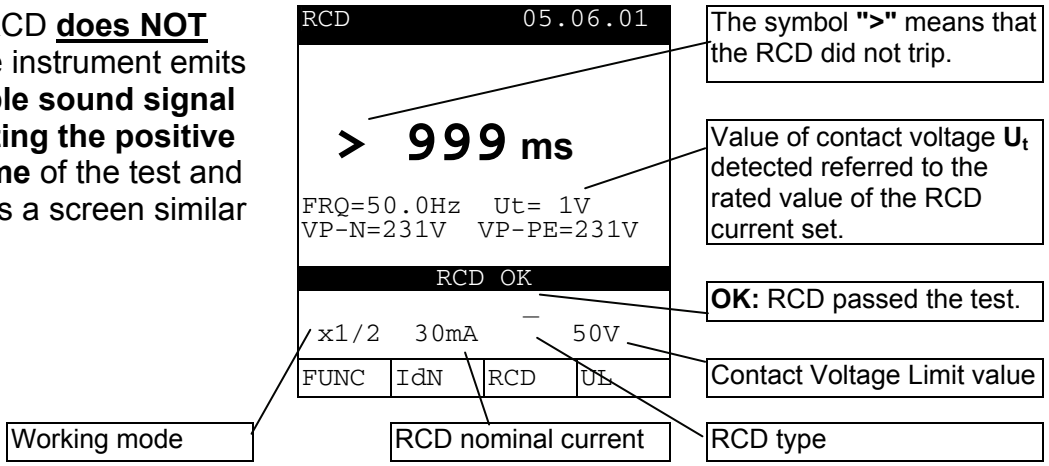
START STOP

4. Press the **START** key **once** to execute a test with **0°** Current waveform.
   or
   Press the **START** key **twice** to execute a test with **180°** Current waveform.

WARNING

Never disconnect the test leads when the message **"MEASURING"** is displayed.

☞ If the RCD **does NOT trip** the instrument emits a **double sound signal indicating the positive outcome** of the test and displays a screen similar to this.


RCD 05.06.01
> 999 ms
FRQ=50.0Hz Ut= 1V
VP-N=231V VP-PE=231V
RCD OK
x1/2 30mA 50V
FUNC IdN RCD UL
The symbol ">" means that the RCD did not trip.
Value of contact voltage Ut detected referred to the rated value of the RCD current set.
OK: RCD passed the test.
Contact Voltage Limit value
Working mode
RCD nominal current
RCD type

SAVE The test can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

6.3.2.2. Results of "*x1, x2, x5*" mode

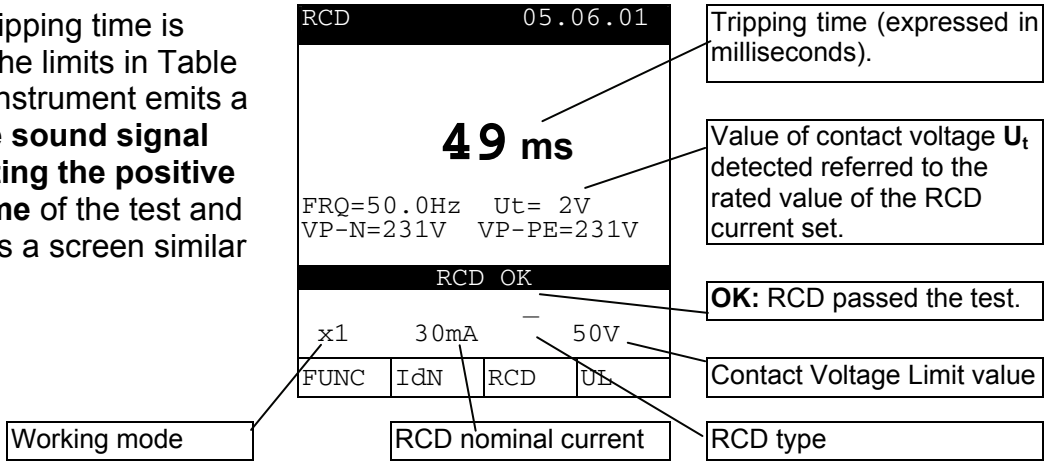
START STOP

4. Press the **START** key **once** to execute a test with **0°** Current waveform.
   or
   Press the **START** key **twice** to execute a test with **180°** Current waveform.

WARNING

Never disconnect the test leads when the message **"MEASURING"** is displayed.

☞ If the tripping time is within the limits in Table 3, the instrument emits a **double sound signal indicating the positive outcome** of the test and displays a screen similar to this.



SAVE The test can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

6.3.2.3. Results of "*AUTO*" mode

START STOP

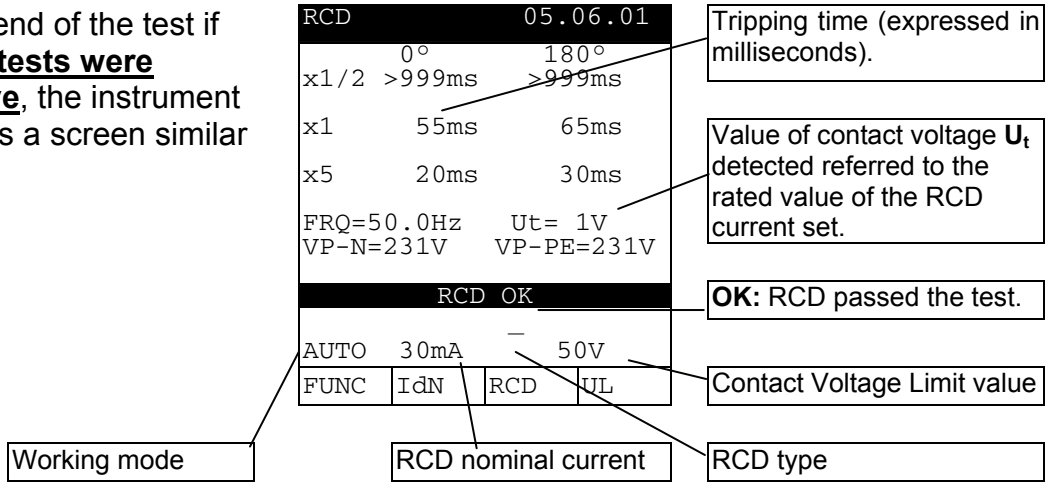
4. Press the **START** key **once** to execute the test. The instrument carries out the following six tests with different values of rated current:
   - ☞ $1/2I_{\Delta n}$ with 0° current waveform (the RCD shall not trip).
   - ☞ $1/2I_{\Delta n}$ with 180° current waveform (the RCD shall not trip).
   - ☞ $I_{\Delta n}$ with 0° current waveform (the RCD trips, message "**RESUME RCD**").
   - ☞ $I_{\Delta n}$ with 180° current waveform (the RCD trips, message "**RESUME RCD**").
   - ☞ $5I_{\Delta n}$ with 0° current waveform (the RCD trips, message "**RESUME RCD**").
   - ☞ $5I_{\Delta n}$ with 180° current waveform (the RCD trips, end of the test).

The test is good if all values of tripping times are within the limits reported in Table 3.

WARNING

Never disconnect the test leads when the message **"MEASURING"** is displayed.

☞ At the end of the test if **all six tests were positive**, the instrument displays a screen similar to this.



SAVE The test can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

6.3.2.4. Results of "*RAMP* ▟" mode

START STOP 4. Press the **START** key **once** to execute a test with **0°** Current waveform.

Or

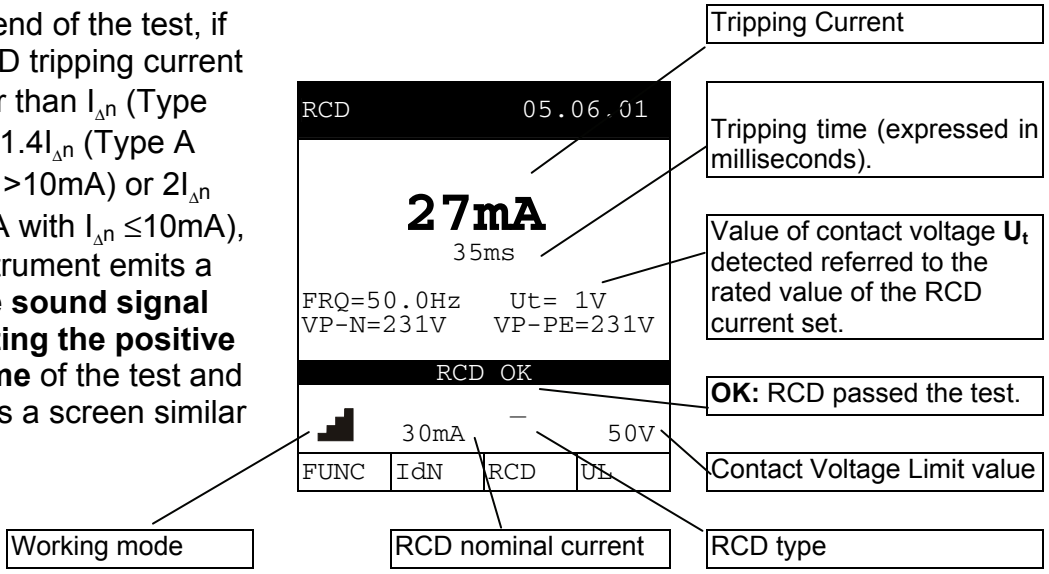
Press the **START** key **twice** to execute a test with **180°** Current waveform.

The instrument generates a leakage current growing step by step for a given time interval.

CAUTION

⚠ Never disconnect the test leads when the message **"MEASURING"** is displayed.

☞ At the end of the test, if the RCD tripping current is lower than $I_{\Delta n}$ (Type AC) or $1.4I_{\Delta n}$ (Type A with $I_{\Delta n}$ >10mA) or $2I_{\Delta n}$ (Type A with $I_{\Delta n} \leq$10mA), the instrument emits a **double sound signal indicating the positive outcome** of the test and displays a screen similar to this.



SAVE The test can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

If the parameters set on the instrument are consistent with the RCD under test, the ramp test "▟" **WILL CAUSE RCD TRIPPING WITH A CURRENT LOWER THAN OR EQUAL TO THE SELECTED RATED DIFFERENTIAL CURRENT.** Do not use this test to compare the trip time with the trip current, as the RCD has to be tested for tripping time with a current equal to and over that of the rated leakage current of the RCD.

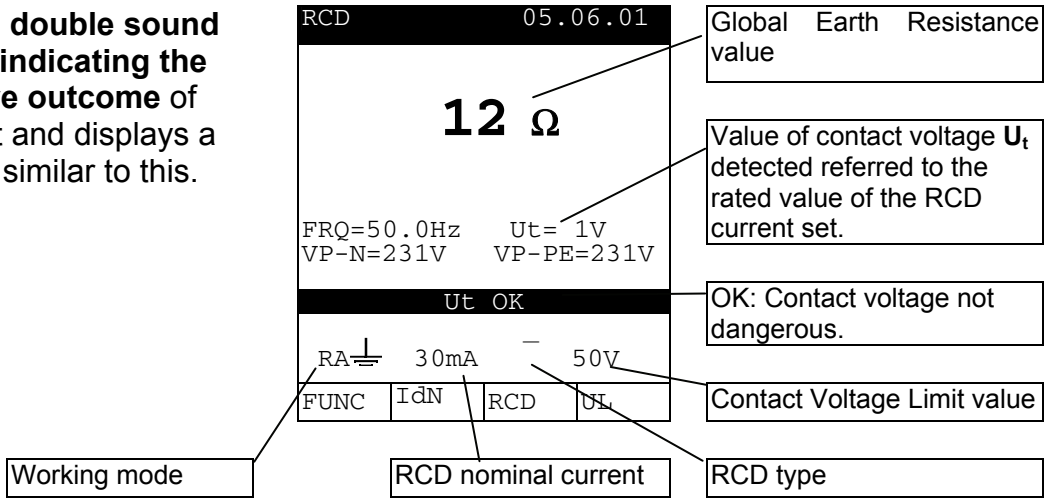
6.3.2.5. Results of "RA⏚" mode

START STOP 4. Press the **START** key **once**: the instrument carries out the test.

WARNING

Never disconnect the test leads when the message **"MEASURING"** is displayed.

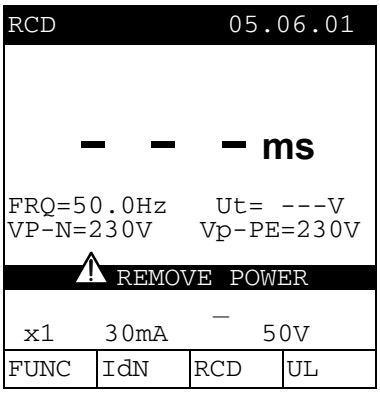
☞ The RCD **must NOT trip** and the instrument emits a **double sound signal indicating the positive outcome** of the test and displays a screen similar to this.



SAVE The test can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

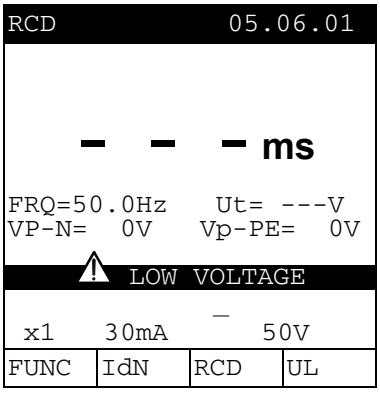
6.3.3. RCD Faulty cases
6.3.3.1. Connection troubles

☞ If the instrument detects the external power supply adapter connected, it will display a screen similar to this



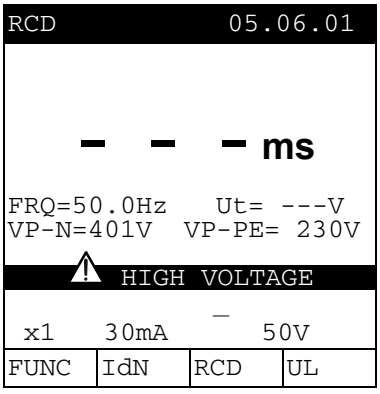
Disconnect the External Power Supply Adapter

☞ Should the instrument detect that the phase and/or neutral cables are not connected to an installation, a screen similar to this displayed when pressing START.



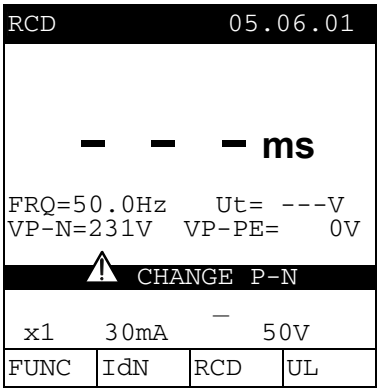
NO VOLTAGE detected

☞ Should the instrument detect a voltage between phase and neutral higher than 250V, for example if the black cable is connected to an installation phase conductor of a 400V three-phase system, a screen similar to this is displayed



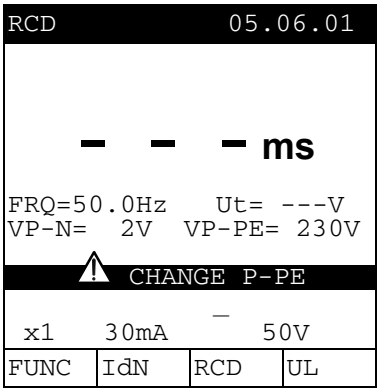
HIGH VOLTAGE Detected

☞ This screen is displayed when the phase conductor has been reversed with the neutral one.
The instrument does not perform the test.
Exchange the red cable with the black one.
Repeat the test



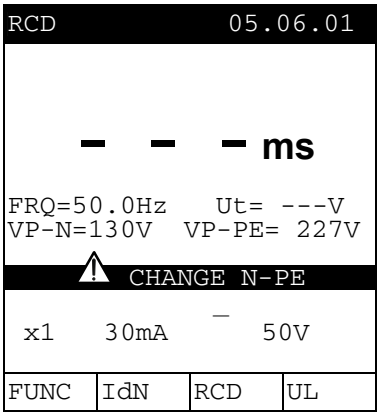
Phase and Neutral Conductors are reversed.

☞ This screen is displayed when the phase conductor has been exchanged with the protective conductor.
The instrument does not perform the test.
Reverse the phase to earth connection in the plug or exchange the red cable with the green one.



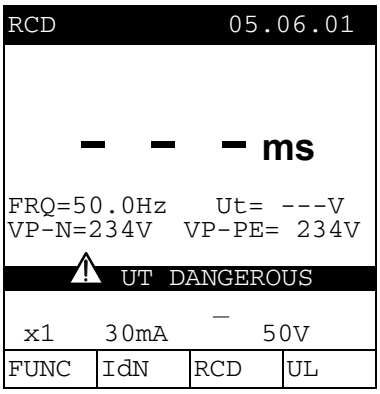
Phase and Protection Conductors are reversed.

☞ This screen is displayed when in a 230V Phase to Phase System the black conductor was reversed with respect to the green one.
The instrument does not perform the test.
Reverse the black and green conductors.



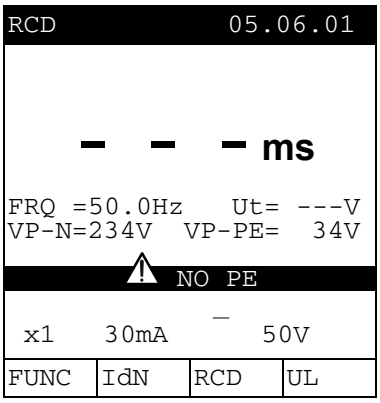
Neutral and Protection Conductors are reversed.

☞ If a contact voltage **U_t higher than the selected limit (U_L)** is detected, the instrument **interrupts** the test and emits **a long sound signal** at the end of the test, and displays a screen similar to this.



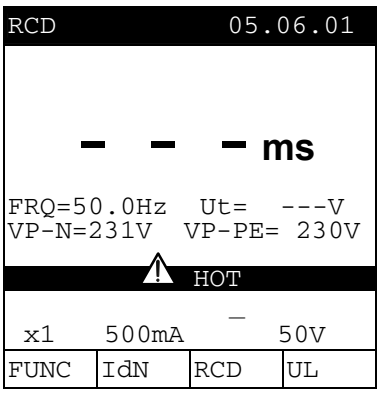
The instrument cannot detect an efficient protection circuit.

☞ If the instrument detects that the earth cable (green) is not connected, the screen alongside is displayed for 5 seconds..Check the connections of the PE conductor under test.



Message **"NO PE"**: the instrument cannot detect an efficient protection circuit.

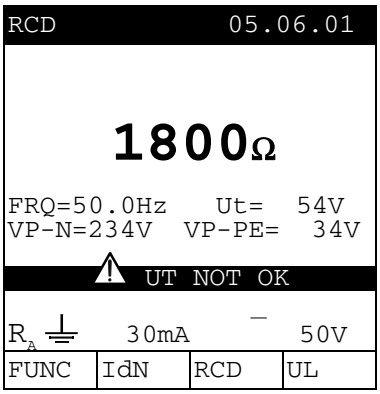
☞ If the instrument gets overheated, tests cannot be carried out and the message alongside is displayed. Wait until the screen reverts to the initial display before proceeding.



Message **"HOT"**: the instrument has overheated.

THE PREVIOUS RESULTS CANNOT BE SAVED.

☞ When using the R_A⏚ function, if a contact voltage **U_t higher than the selected limit (U_L)** is detected, the instrument emits **a long sound signal** at the end of the test and displays a screen similar to this.

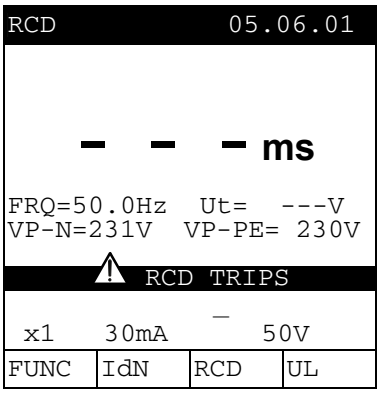


The instrument cannot detect an efficient protection circuit.

SAVE The test can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

6.3.3.2. RCD tripping "faulty cases"

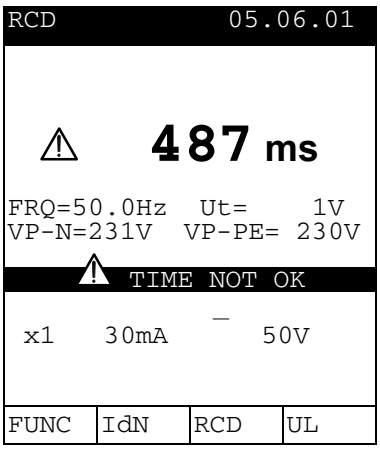
☞ If the RCD trips during the preliminary test (regardless of the working mode) the instrument displays a screen similar to this.



The RCD trips too early. Check if the RCD nominal current is correct. Some leakage currents may be present in the installation. Disconnect all the loads downstream of the RCD.

THE PREVIOUS RESULTS CANNOT BE SAVED.

☞ If during tests MAN x1, x2, x5 and AUTO (during x1 and x5 tests), the RCD trips to break the circuit outside the limits reported in Table 3, the instrument emits **a long sound signal** at the end of the test and displays a screen similar to this.

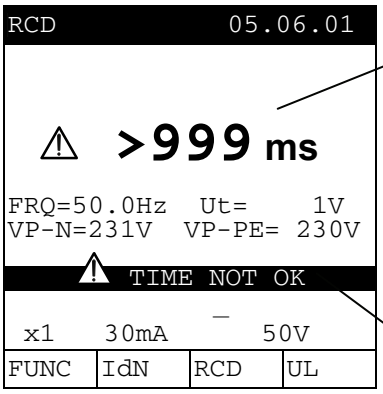


RCD tripping time.

ATTENTION: the tripping time is higher than the standard limit.

SAVE The test can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

☞ If the RCD tripping time is higher than the instrument's measuring limits, the instrument emits **a long sound signal** at the end of the test and displays a screen similar to this.



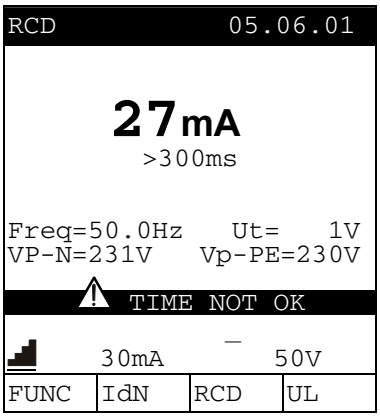
RCD tripping time is greater than the maximum measurable time (it depends on type of test, see following table).

ATTENTION: the tripping time is higher than the standard limit.

The maximum duration depends on the test type:

Test type	General RCD	Selective RCD
MAN x1 test	999ms	999ms
MAN x2 test	200ms	250ms
MAN x5 test	50ms	160ms
"▟" test	300ms	

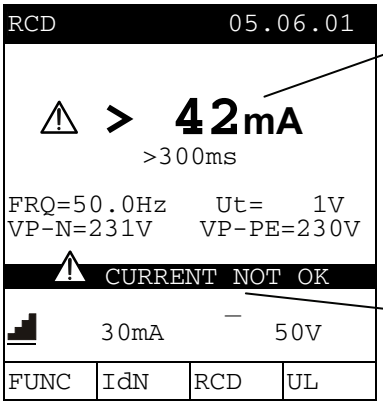
☞ During the ramp ▟ test if the RCD tripping time is higher than the limit, the instrument emits **a long sound signal** at the end of the test and displays a screen similar to this.



Tripping Current

Tripping time exceeds the limit value

☞ If during the ramp ▟ test the RCD tripping current is higher than $I_{\Delta n}$ (Type AC) or 1.4 $I_{\Delta n}$ (Type A with $I_{\Delta n}$>10mA) or 2 $I_{\Delta n}$ (Type A with $I_{\Delta n}$≤10mA), the instrument emits **a long sound signal** at the end of the test and displays a screen similar to this.

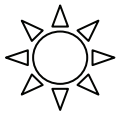


Maximum current generated by the instrument during the test for general RCDs (the value indicated is referred to an AC type 30mA RCD, in this case the maximum current supplied is equal to $1.4xI_{\Delta N}$

ATTENTION:
The RCD tripping current is higher than the nominal value ($I_{\Delta N}$=30mA was set in the example).

SAVE The previous results can be be stored pressing the **SAVE** key **twice** (see paragraph 8.1).

6.4. LOOP ↻: MEASUREMENT OF LINE IMPEDANCE, FAULT LOOP IMPEDANCE, PROSPECTIVE SHORT CIRCUIT CURRENT CALCULATION AND PHASE SEQUENCE INDICATOR



Turn the **switch** on **LOOP** ↻ position.

F1

The **F1** key selects one of the following measuring modes:

- ☞ Mode "**P-N**" (the instrument measures the impedance between the phase and neutral conductors and calculates the phase to neutral prospective short circuit current).
- ☞ Mode "**P-P**" (the instrument measures the impedance between two phase conductors and calculates the phase to phase prospective short circuit current).
- ☞ Mode "**P-PE**" (the instrument measures the impedance between the phase and protective conductors and calculates the phase to earth prospective short circuit current).
- ☞ Mode "**R_A⏚**" (the instrument measures the impedance between the phase and protective conductors with a test current of 15mA in order to avoid RCD tripping and calculates the phase to earth prospective short circuit current).
- ☞ Mode "↻" (the instrument detects the Phase Sequence in a three-phase system).

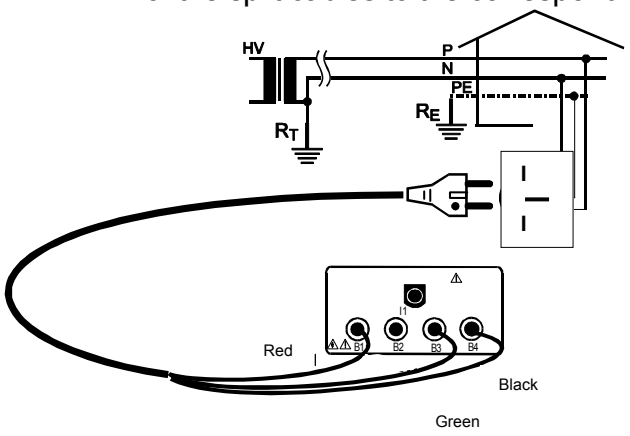
WARNING

Never disconnect the test leads when the message **"MEASURING"** is displayed.

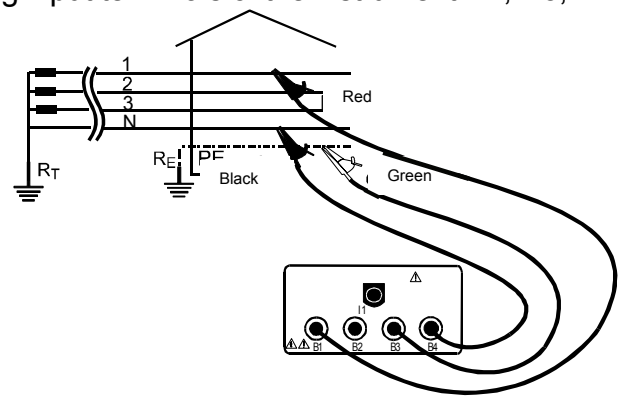
6.4.1. Measurement procedure and results of "P-N" mode

F1

1. Select **P-N** mode by means of the **F1** key.
2. Connect the Red, Green and Black connectors of the three-terminal mains cable or of the split cables to the corresponding input terminals of the instrument **B1**, **B3**, **B4.**



Instrument connection for P-N test in a 230V single-phase System



Instrument connection for P-N in a 400V three-phase system

3. Connect the mains plug into a 230V 50Hz socket or the croc clips to the conductors of the three-phase system (see previous pictures).
4. If possible disconnect all low impedance loads downstream of the point at which the measurement is to be taken, as such impedances would be in parallel with the line impedance to be measured.

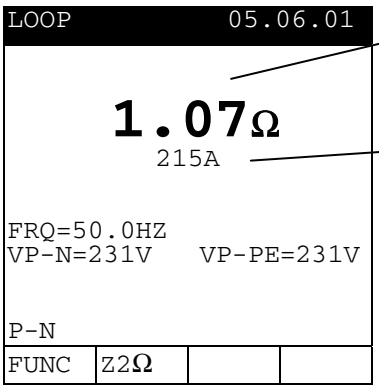
START STOP

5. Press the **START** key. The instrument starts the test.

WARNING

The measurement in a 230V system uses a test current of 6A approx. This may cause the tripping of protective devices with nominal values lower than 10A. If necessary perform the test upstream of the protection. Never disconnect the test leads when the message **"MEASURING"** is displayed.

☞ At the end of the test the instrument emits a **double sound signal indicating that the test completely correctly** and displays a screen similar to this.



Value of phase to neutral line impedance expressed in Ω.

Value of the phase to neutral prospective short circuit current expressed in amperes calculated according to the following formula.

Working mode

Formula for calculation of prospective short circuit current:

$$I_{CC} = \frac{U_N}{Z_{PN}}$$

Where U_N = Nominal phase to neutral voltage = 127 if $V_{meas} \leq 150$

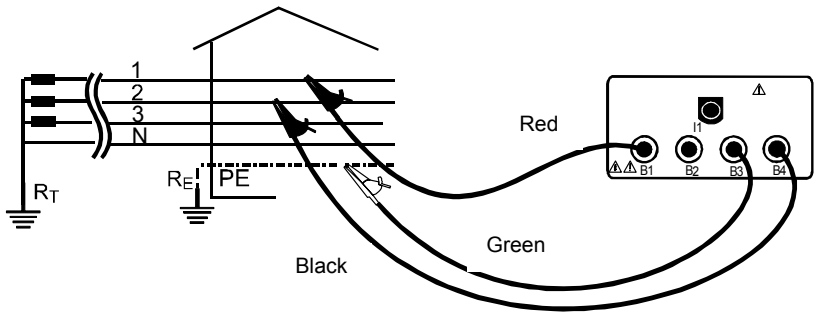
230 if $V_{meas} > 150 \leq 250$

SAVE This result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

6.4.2. Measurement procedure and results of "P-P" mode

F1 1. Select **P-P** mode by means of the **F1** key.

2. Connect the Red, Green and Black connectors of the three-terminal mains cable or of the split cables to the corresponding input terminals of the instrument **B1**, **B3**, **B4**



Instrument connection for P-P test in a 400V three-phase system

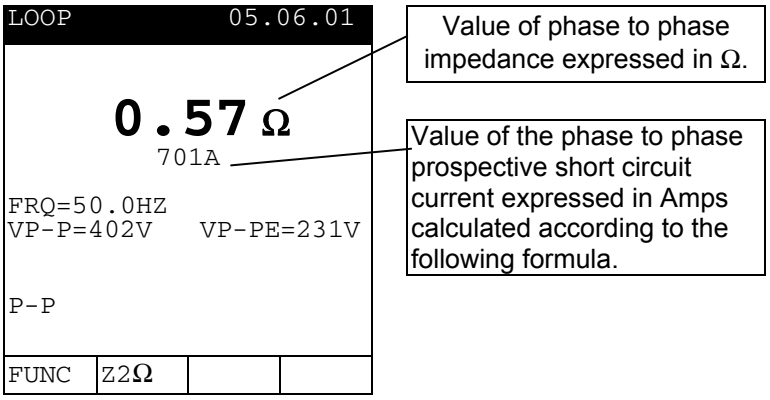
3. Connect the mains plug into a 230V 50Hz socket or the croc clips to the conductors of the three-phase system (see previous pictures).
4. If possible disconnect all low impedance loads downstream of the point at which the measurement is to be taken, as such impedance would be in parallel with the line impedance to be measured.

START STOP 5. Press the **START** key. The instrument starts the test.

WARNING

The P-P measurements in a 400V system use a test current of 11.5A approx. This may cause the tripping of protective devices with nominal value lower than 10A. If necessary perform the test upstream of the protection. Never disconnect the test leads when the message **"MEASURING"** is displayed.

☞ At the end of the test the instrument emits a **double sound signal indicating that the test is correctly terminated** and displays a screen similar to this.



Formula for calculation of prospective short circuit current:

$$I_{CC} = \frac{U_N}{Z_{PP}}$$

Where U_N= phase to phase voltage

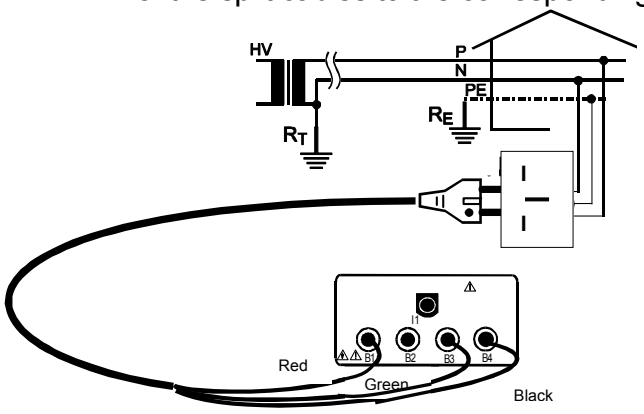
127 if $V_{meas} \leq 150$
230 if $V_{meas} > 150V \leq 260$
400 if $V_{meas} > 260$

SAVE This result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

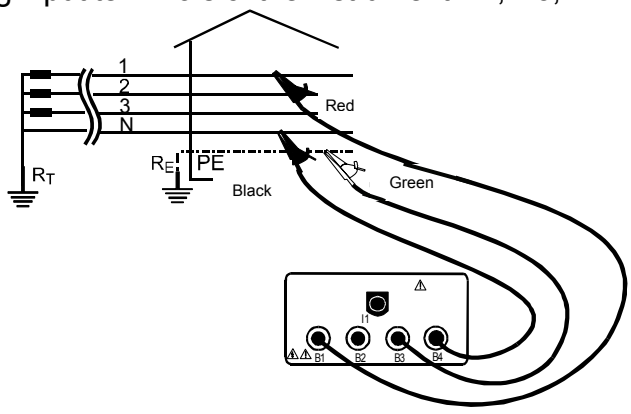
6.4.3. Measurement procedure and results of "P-PE" mode

F1 1. Select **P-PE** mode by means of the **F1** key.

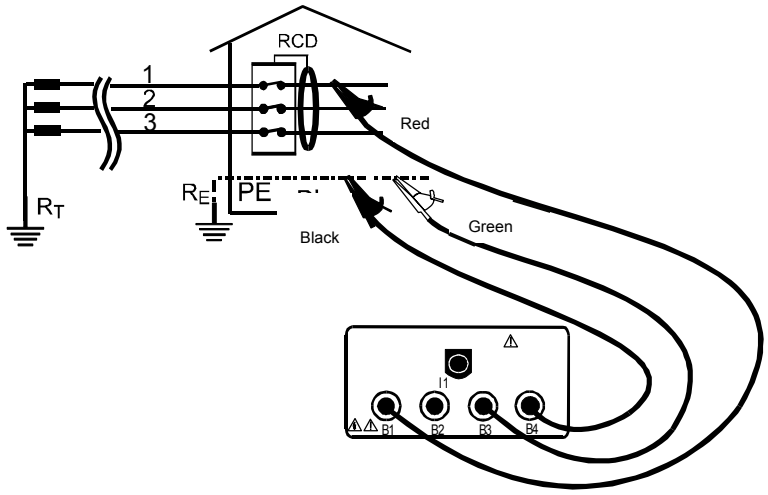
2. Connect the Red, Green and Black connectors of the three-terminal mains cable or of the split cables to the corresponding input terminals of the instrument **B1**, **B3**, **B4**.



Instrument connection for P-PE test in a 230V single-phase System



Instrument connection for P-PE in a 400V three-phase system



Instrument connection for P-PE in a 400V three-phase system without Neutral conductor

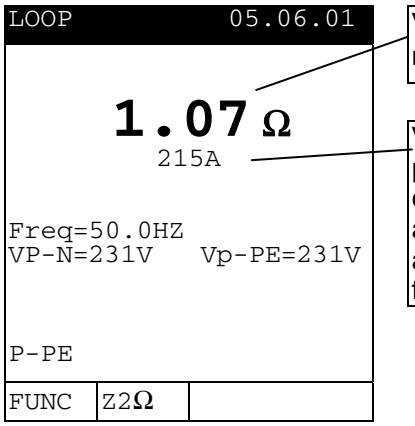
3. Connect the mains plug into a 230V 50Hz socket or the croc clips to the conductors of the three-phase system (see previous pictures).
4. The key **F4** permits to select one of the following **limit values for the contact voltage** (which can be shown cyclically when pressing the key):
   - ☞ 50V (default).
   - ☞ 25V.

START STOP 5. Press the **START** key **once** to execute a test injecting a current <u>in phase with positive half wave of the</u> voltage.
Press the **START** key **twice** to execute a test injecting a current in <u>phase with negative half wave of the voltage.</u>

WARNING

The P-PE measurement in a 230V System uses a test current of 6A approx. This may cause the tripping of protective devices with nominal value lower than 10A and **will cause the tripping of an RCD device**. If necessary perform the test upstream of the protection or RCD. Never disconnect the test leads when the message **"MEASURING"** is displayed

☞ At the end of the test the instrument emits a **double sound signal indicating that the test completed correctly** and displays a screen similar to this.



Value of phase to earth resistance expressed in Ω.

Value of the phase to earth prospective short circuit current expressed in amperes calculated according to the following formula.

Working mode

Formula for calculation of prospective short circuit current:

$$I_{CC} = \frac{U_N}{Z_{PE}}$$

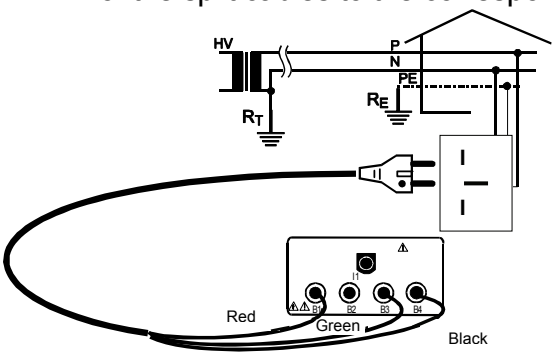
Where U_N = Nominal phase to neutral voltage = 127 if $V_{meas} \leq 150$
230 if V_{meas} >150V ≤ 250

SAVE This result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

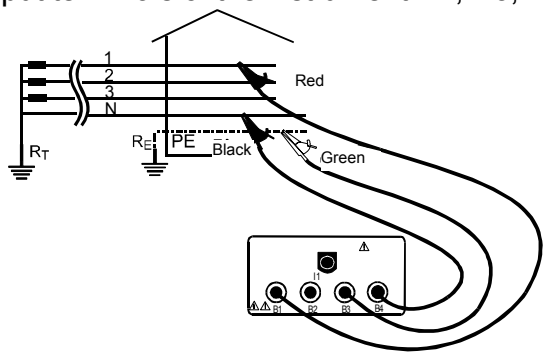
6.4.4. Measurement procedure and results of " R_A⏚" mode

F1

1. Select R_A⏚ mode by means of the **F1** key.
2. Connect the Red, Green and Black connectors of the three-terminal mains cable or of the split cables to the corresponding input terminals of the instrument **B1**, **B3**, **B4**.



Instrument connection for P-PE test in a 230V single-phase System



Instrument connection for P-PE in a 400V three-phase system

3. Connect the mains plug into a 230V 50Hz socket or the croc clips to the conductors of the three-phase system (see previous pictures).
4. If possible disconnect all low impedance loads downstream of the point at which the measurement is to be taken, as such impedance would be in parallel with the line impedance to be measured.
5. The key **F4** permits to select one of the following **limit values for the contact voltage** (which can be shown cyclically when pressing the key):
   - ☞ 50V (default)
   - ☞ 25V.

START STOP

6. Press the **START** key **once** to execute a test with "**0°**" test current.

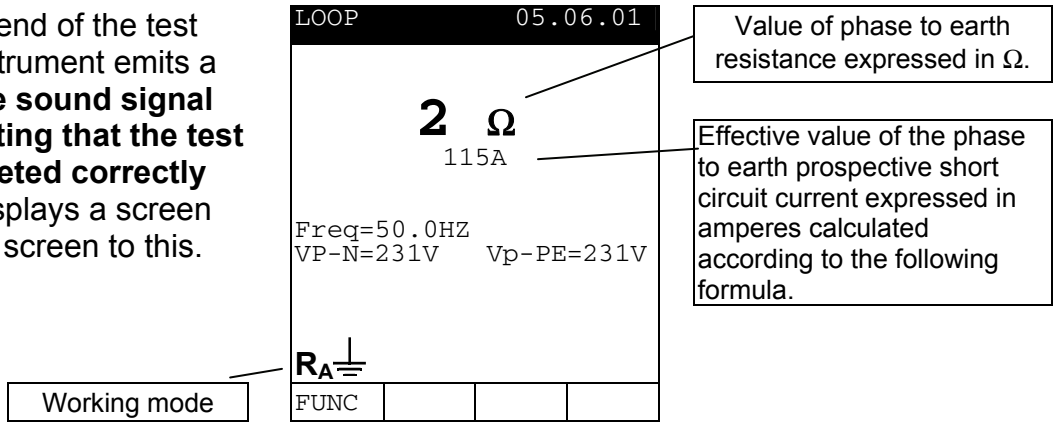
or

Press the **START** key **twice** to execute a test with "**180°**" test current.

WARNING

The R_A⏚ measurement uses a test current of 15mA. This may cause the tripping of 10mA devices. If necessary perform the test upstream of the device. Never disconnect the test leads when the message **"MEASURING"** is displayed.

☞ At the end of the test the instrument emits a **double sound signal indicating that the test completed correctly** and displays a screen similar screen to this.


LOOP 05.06.01
2 Ω
115A
Freq=50.0HZ
VP-N=231V Vp-PE=231V
RA⏚
FUNC
Value of phase to earth resistance expressed in Ω.
Effective value of the phase to earth prospective short circuit current expressed in amperes calculated according to the following formula.
Working mode

Formula for calculation of prospective short circuit current: $I_{CC} = \frac{U_N}{Z_{PE}}$

Where U_N = Nominal phase to neutral voltage = 127 if $V_{meas} \leq 150$
230 if $V_{meas} > 150V \leq 250$

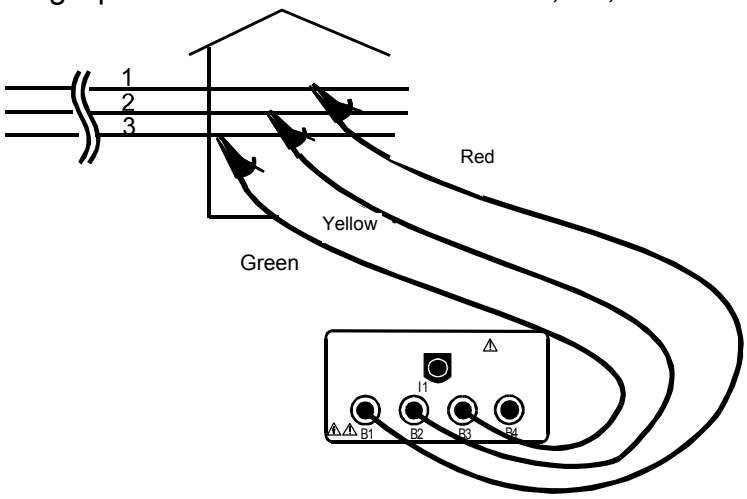
SAVE

This result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

6.4.5. Measurement procedure and results of "↻" mode

F1 1. Select ↻ mode by means of the **F1** key.

2. Connect the Red, Yellow and Green connectors of the split cables to the corresponding input terminals of the instrument **B1**, **B2**, **B3**.

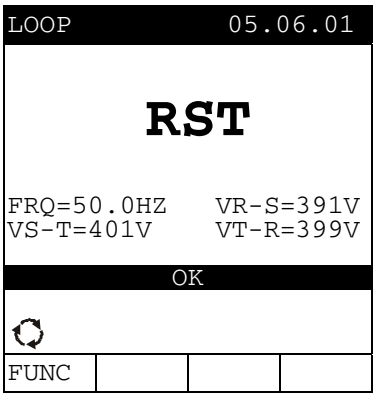


Instrument connection for Phase Sequence Detection in a 400V three-phase system

START STOP 3. Press the **START** key to execute a test.

☞

At the end of the test the instrument emits a **double sound signal indicating that the test completed correctly** and displays a screen similar to this.



Phase sequence OK

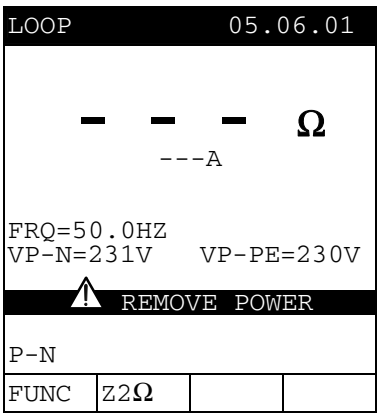
Value of the phase to phase voltage

Working mode

SAVE This result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

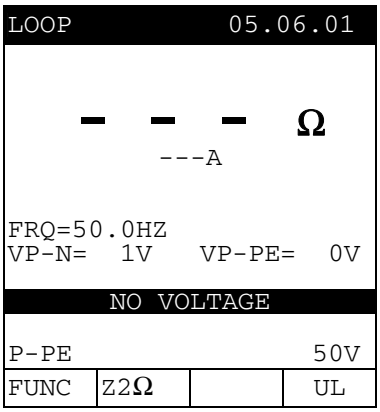
6.4.6. LOOP Faulty Cases

☞ If the instrument detects the external power supply adapter connected, the instrument will show a screen similar to this.



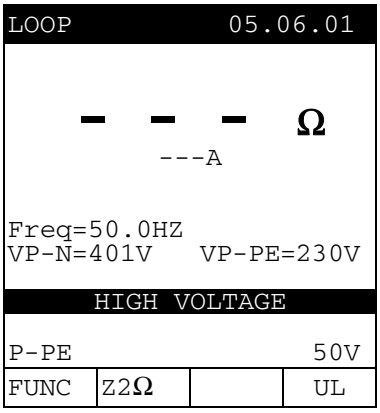
Disconnect the External Power Supply Adapter

☞ Should the instrument detect that the phase and/or neutral cables are not connected, a screen similar to this is displayed when pressing START.



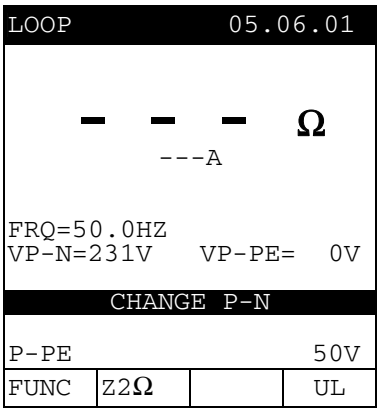
NO VOLTAGE detected

☞ Should the instrument detect a voltage between phase and neutral higher of 250V, for example where the black cable is connected to an installation phase conductor of a 400V three-phase system, a screen similar to this is displayed.



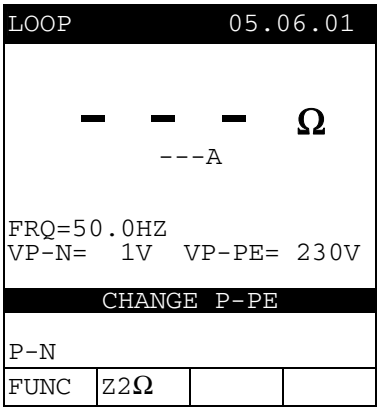
HIGH VOLTAGE detected

☞ A screen similar to this is displayed when the phase conductor has been reversed with the neutral one.
The instrument does not perform the test.
Exchange the red cable with the black one.



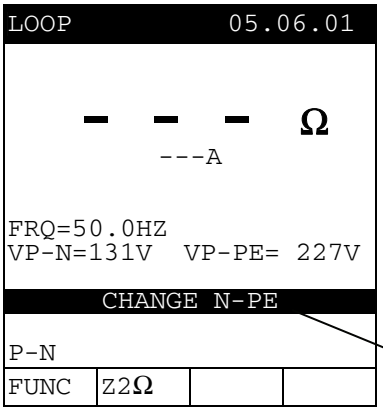
Phase and Neutral conductors are reversed.

☞ A screen similar to this is displayed when the phase conductor has been exchanged with the protective conductor.
The instrument does not perform the test.
Exchange the red cable with the green one.



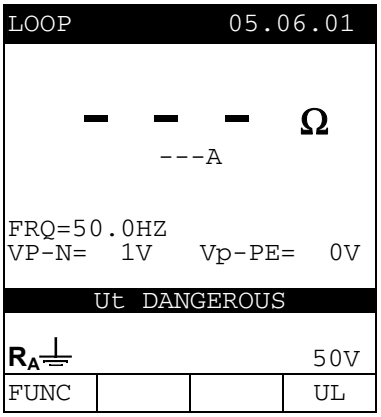
Phase and Protective conductors are reversed.

☞ This screen is displayed when in a 230V Phase to Phase System the black conductor was reversed with respect to the green one.
The instrument does not perform the test.
Reverse the black and green conductors.



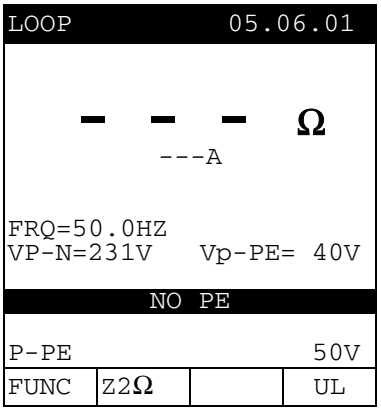
Neutral and Protection conductors are reversed.

☞ If a contact voltage **U_t higher than the selected limit (U_L)** is detected, the instrument interrupts the test and emits **a long sound signal** and displays a screen similar to this.



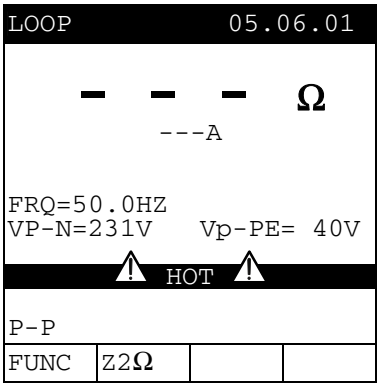
Message **"Ut"**: the instrument cannot detect an efficient protection circuit.

☞ Should the instrument detect an extremely high earth resistance, suggesting that there is no earth protection, a screen similar to this is displayed.
Please check the efficiency of PE conductor and earth installation.



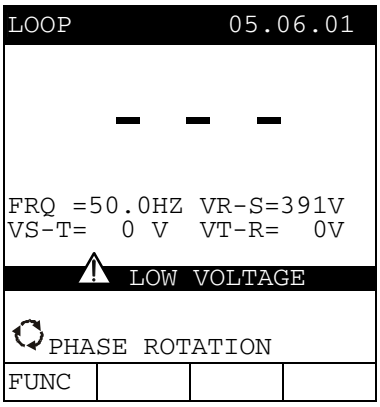
Message **"NO PE"**: the instrument cannot detect an efficient protection circuit.

☞ If the instrument gets overheated, tests cannot be carried out and the message alongside is displayed. Wait until the screen reverts to the initial display in order to proceed with measurements.



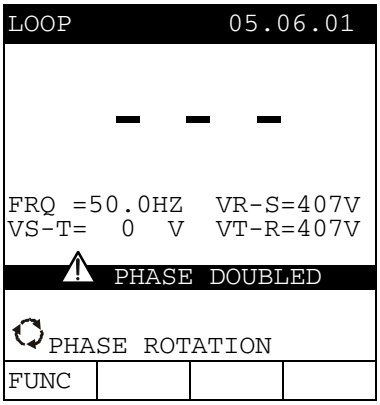
Message "**HOT**": the instrument has overheated.

☞ Using the "↻" mode, if a Phase to Phase voltage is lower than 100V, the instrument displays a screen similar to this.



Phase to phase voltage is lower than 100V

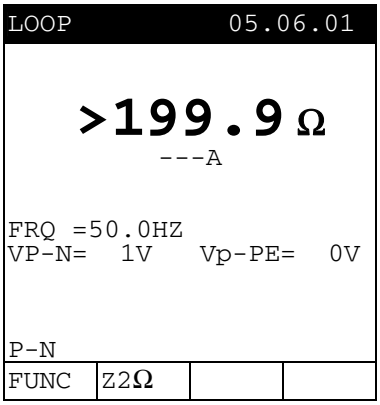
☞ Using the "↻" mode, if the instrument detects that two phases are connected together, it displays a screen similar to this.



Two phases are connected together.

<u>THE PREVIOUS RESULTS CANNOT BE SAVED</u>.

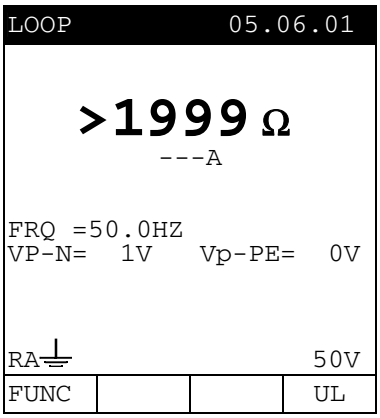
☞ If in modes **P-P** and **P-N** the instrument carries out the test and detects a **resistance higher than 199.9Ω**, a screen similar to this displayed.



Message ">199.9" means that the resistance measured is higher than the maximum measurable

SAVE This result can be stored pressing the **SAVE** key **twice** (see paragraph 8.1).

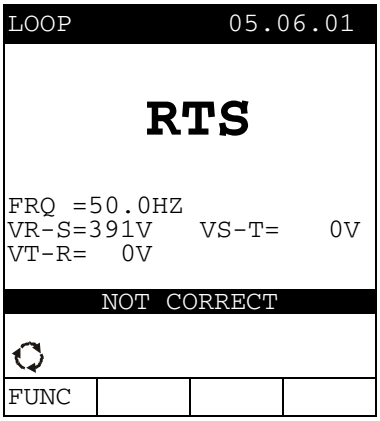
☞ If in modes **P-PE**, R_A⏚ the instrument carries out the test and detects a **resistance to be higher than 1999Ω**, a screen similar to this is displayed.



Message ">1999" means that the Resistance measured is higher than the maximum measurable

SAVE This result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

☞ In the ↻ mode, if the voltage of one or more phases is too low, the instrument will show a screen similar to this.

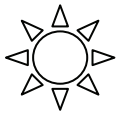


Phase sequence incorrect

Phase voltages incorrect

SAVE This result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

6.5. EARTH: SOIL RESISTANCE AND RESISTIVITY MEASUREMENTS



Turn the **switch** to the **EARTH** position.

F1 The **F1** key selects one of the following measuring modes (which can be shown cyclically when pressing the key):

- ☞ Mode "2-W" (the instrument measures the resistance between 2 points).
- ☞ Mode "3-W" (the instrument measures the resistance using two auxiliary earth rods).
- ☞ Mode "ρ" (the instrument measures the ground resistivity).

At the end of each test, the instrument automatically shows the average value of Earth Resistance or Earth Resistivity calculated on the basis of the measured values.

F2 The **F2** key clears the average value of Earth Resistance or Earth Resistivity and the test counter.

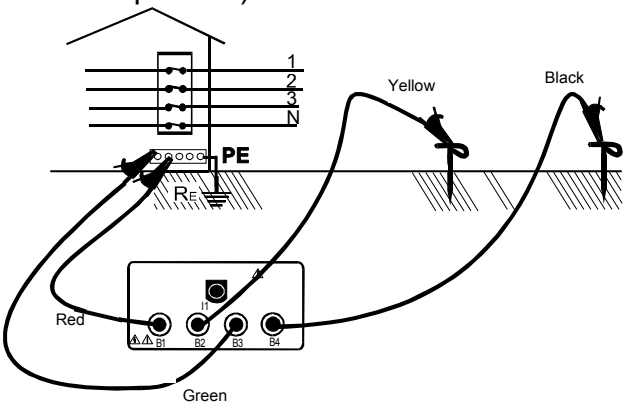
WARNING

Never disconnect the test leads from the circuit under test when the message **"MEASURING"** is displayed

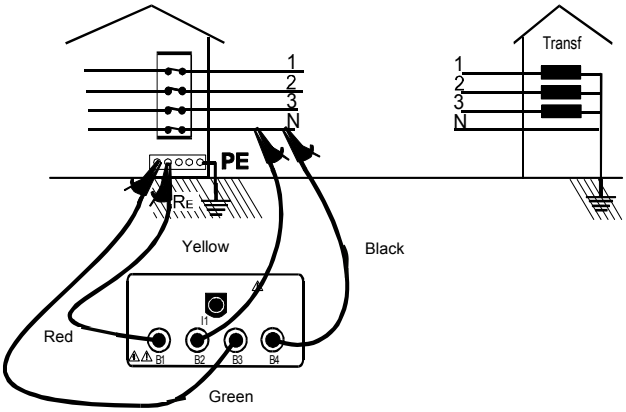
6.5.1. Measurement procedure and results of "2-W"and "3-W" mode

F1

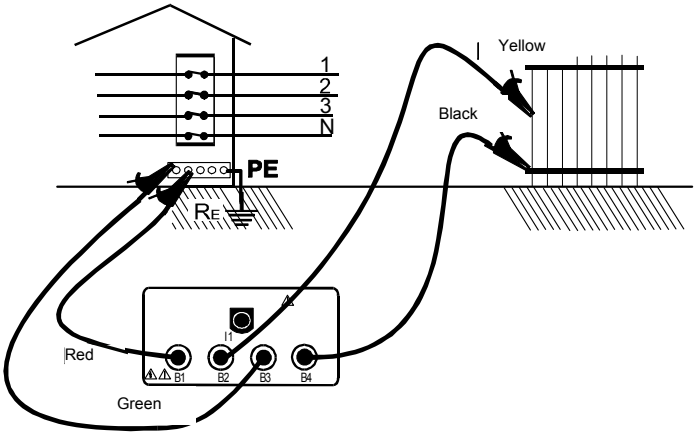
1. Select "**2-W**" or "**3-W**" Earth measurement mode by means of the **F1** key.
2. Connect the Red, Yellow, Green and Black cables to the corresponding input terminals of the instrument **B1**, **B2**, **B3**, **B4** (see possible connections in the following pictures).



Connections for 3 point Earth resistance measurement



Connections for 2 point Earth Resistance measurement

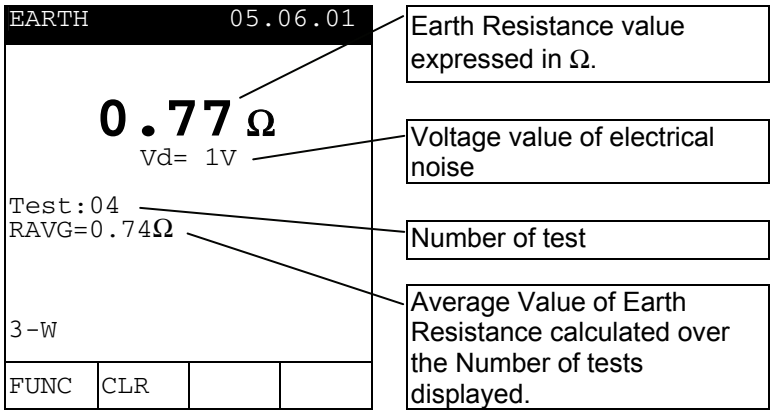


Connections for measuring the resistance between an extraneous conductive part and the earth system

START STOP

3. Press the **START** key. The instrument starts the test.

☞ At the end of the test the instrument emits a **double sound signal indicating that the test completed correctly** and displays a screen similar to this.



4. The instrument will automatically show the average value of the earth resistance . Press **F2** to RESET this value and the test counter.

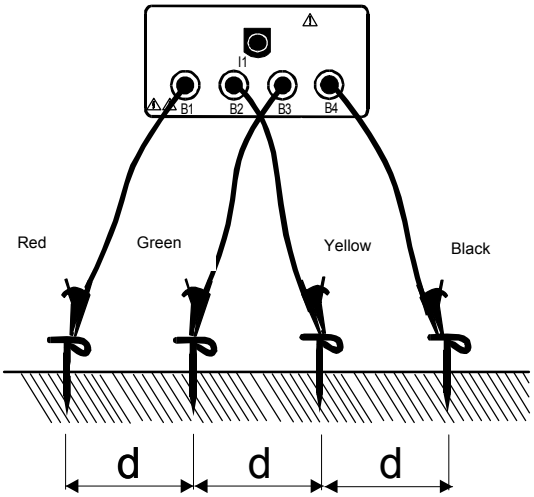
SAVE

This result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

6.5.2. Measurement procedure and results of "ρ" mode

F1

1. Select ρ measurement mode by using the **F1** key.
2. Select the distance **d** between the earth rods by using the **F3** and **F4** keys.
3. Connect the Red, Green, Yellow and Black connectors of the single cables to the corresponding input terminals of the instrument **B1**, **B2**, **B3**, **B4**.

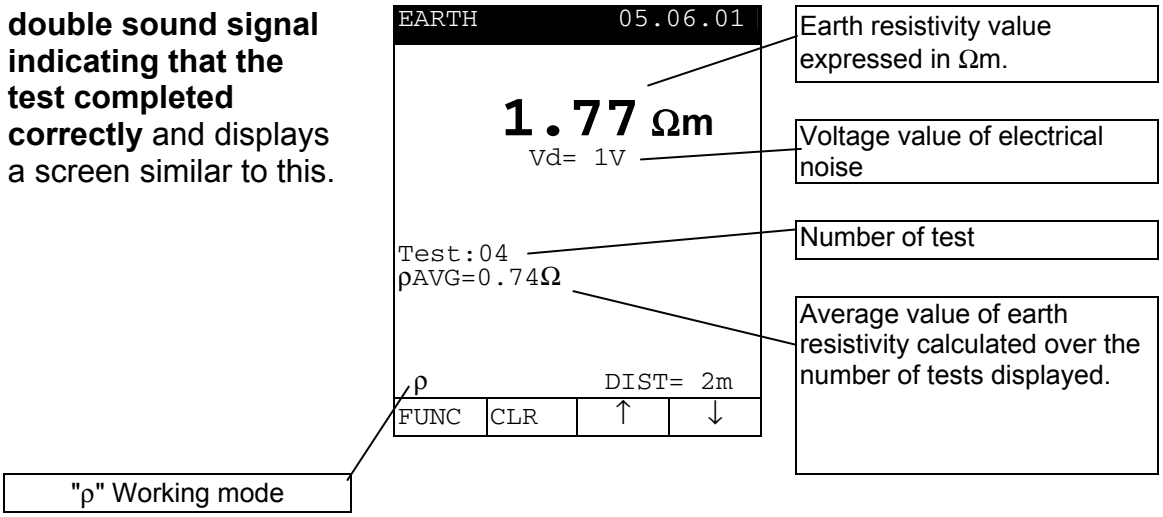


Instrument connection for Earth resistivity measurement

START STOP

4. Press the **START** key. The instrument starts the test.

☞ At the end of the test the instrument emits a **double sound signal indicating that the test completed correctly** and displays a screen similar to this.



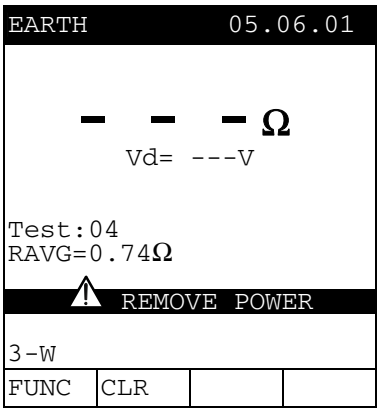
5. The instrument will automatically show the average value of the earth resistance. Press **F2** to RESET this value and the test counter.

SAVE

This result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

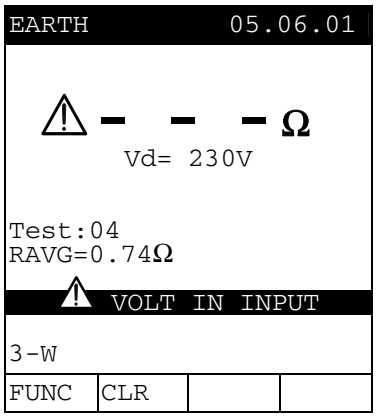
6.5.3. "2-W", "3-W" and "ρ" faulty cases

☞ If the instrument detects the external power supply adapter connected to the instrument it will show a screen similar to this.



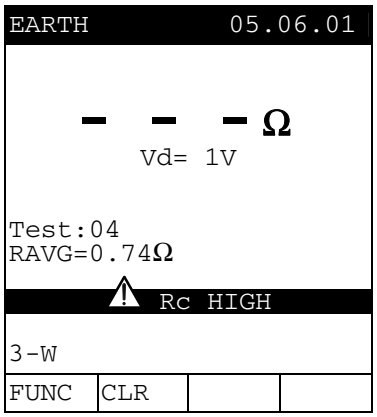
Disconnect the External Power Supply Adapter

☞ If the Instrument detects a voltage value higher than 5V the instrument will show a screen similar to this.



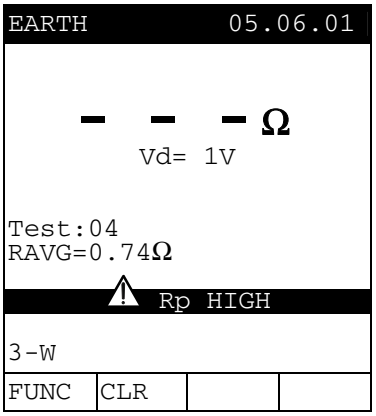
Warning symbol: voltage noise on input.

☞ The message "**Rc HIGH**" indicates that the instrument cannot produce the minimum current necessary for the measurement. Check that the terminals are correctly connected and that the auxiliary earth rod connected to B4 (black conductor) has not been inserted into pebbly or poor conductive ground.



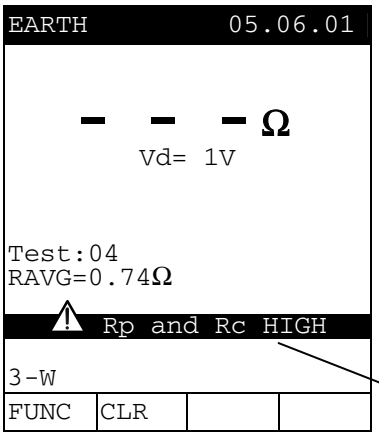
Message "Rc HIGH": Check auxiliary earth rods.

☞ The message "**Rp HIGH**" indicates that the instrument cannot produce the minimum current necessary for the measurement. Check that the terminals are correctly connected and the auxiliary earth rod connected to B2 (yellow conductor) has not been inserted into pebbly or poor conductive ground.



Message "Rp HIGH": Check auxiliary earth rods.

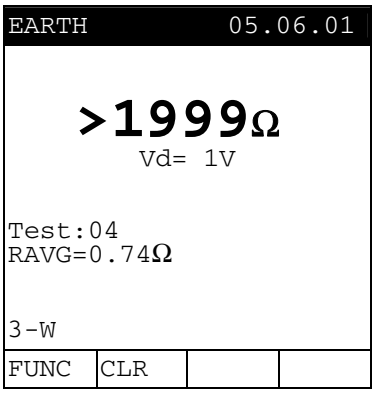
☞ The message "**Rp and Rc HIGH**" indicates that the instrument cannot produce the minimum current necessary for the measurement. Check that the terminals are correctly connected and that the auxiliary earth rod connected to B2 (yellow conductor) and B4 (black conductor) have not been inserted in a pebbly or poor conductive ground.



Message "Rp and Rc HIGH": Check auxiliary earth rods.

THE PREVIOUS RESULTS CANNOT BE SAVED.

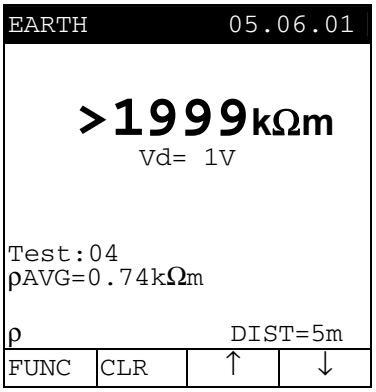
☞ If the instrument detects a resistance value higher than 1999Ω, it will display a screen similar to this.



Message ">1999" means that the resistance value is higher than the maximum measurable.

SAVE This result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

☞ If the instrument detects a resistivity value higher than 1999kΩ, it will display a screen similar to this.



Message ">1999" means that the resistivity value is higher than the maximum measurable.

SAVE This result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

6.6. LEAKAGE CURRENT: REAL TIME MEASUREMENT

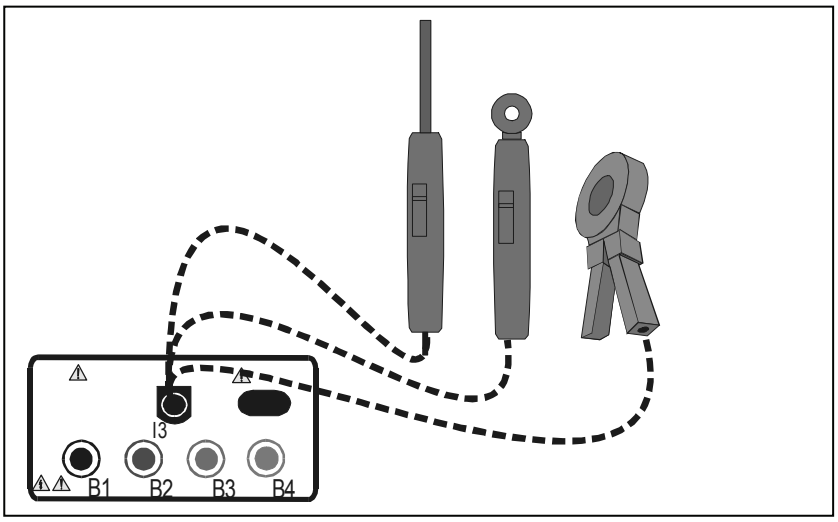
This working mode allows the user to perform real time measurement and recording of Leakage Current, using the External Flexible Clamp.

Turn the **switch** to the "**AUX**" position.

F1 1. On pressing this key you will change the measuring unit of the instrument's input. The following possibilities will be displayed cyclically:

- -	(Instrument's input disabled)
mA	(Leakage current)
Others	(not supported)

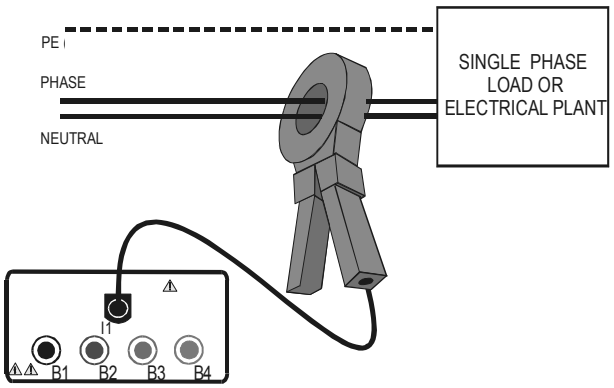
2. Connect the External Flexible Clamp to the instrument's "I1" input.
3. Check if the selector on the probe or clamp is adjusted to the range set on the instrument. Both ranges must be set to the same value.



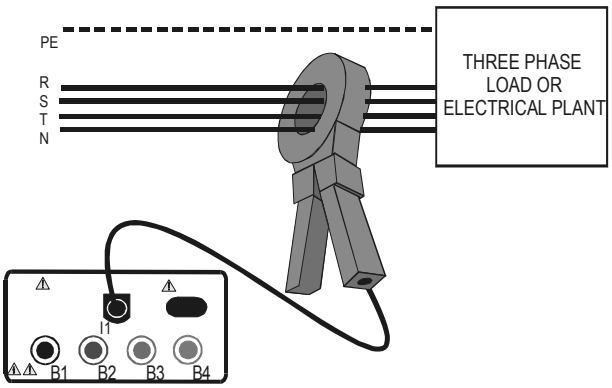
Example of External probe connections

WARNING

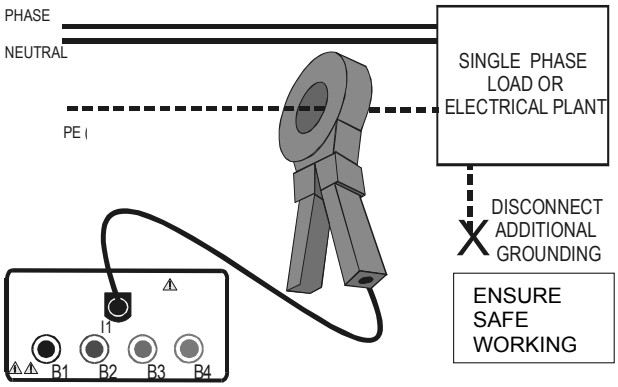
Never leave probes connected to the instrument when not in use, even with the probe switched off.



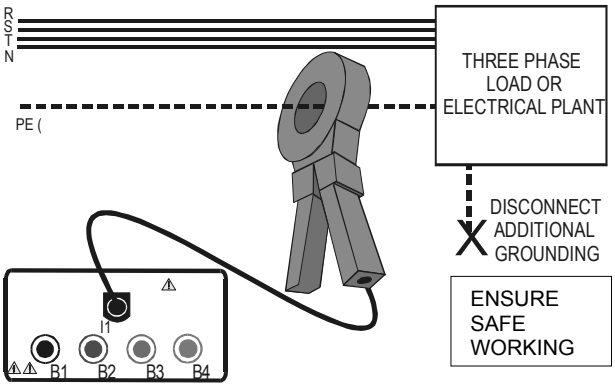
Indirect Leakage Current measurement in a single phase system



Indirect Leakage Current measurement in a three phase system



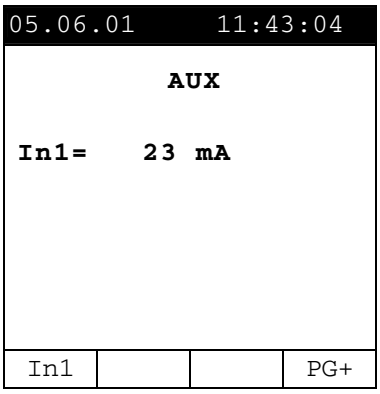
Direct Leakage Current measurement in a single phase system



Direct Leakage Current measurement in a three phase system

4. The Instrument shows in real time the values present at the inputs.

☞ Example of screen.



Example of Input Signal 1

HOLD ENTER

5. Press this key to enable/disable the HOLD function. When the HOLD function is enabled, the word HOLD is displayed. This key is disabled during a recording. It is not possible to run a recording if this function is enabled.

SAVE

6. The displayed result can be stored by pressing the **SAVE** key **twice** (see paragraph 8.1).

6.7. LEAKAGE CURRENT: RECORDING

Before starting a recording we recommend the user checks that **real time values** are correct, and then follow the measurement procedure described in paragraph 6.6.

In addition, it is fundamental that instrument settings correspond to the accessories in use. For this we recommend that the user checks the instrument's settings before executing an AUX recording.
Please check the RECORDER CONFIG settings as follows:

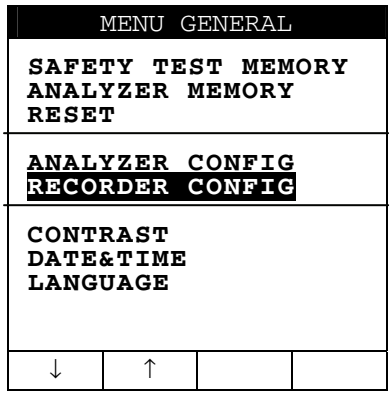
- ☞ **MENU**: Press to enter the **MENU** mode and change the instrument settings. It is not possible to enter the configuration MENU during a recording or an energy measurement.
- ☞ **START/STOP**: Press to record the **selected parameters** according to the instrument's settings (see chapter 9).

6.7.1. AUX Basic setting: RECORDER CONFIG

Place the rotary switch in the **AUX** position, press the **MENU** key, use the **F1**/**F2** keys to select the **RECORDER CONFIG** item and press the **ENTER** Key.

WARNING

It is not possible to enter the MENU during a recording or a Real Time Energy measurement.

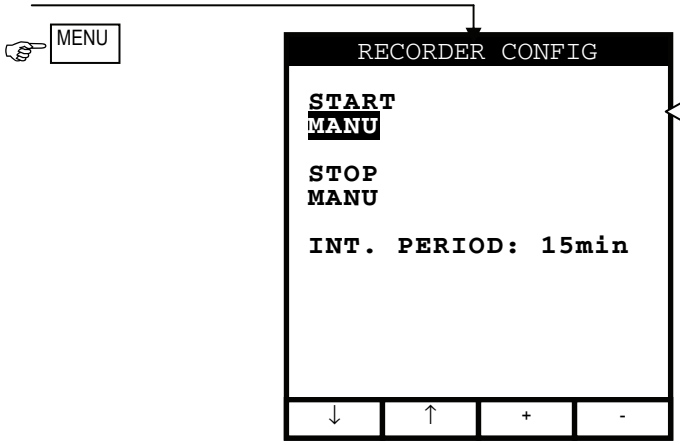


In **RECORDER CONFIG** mode, it is possible to carry out the following operations:

- Setting of Start/Stop recording mode (AUTO or MANUAL), and the hour and date of Start/Stop (in AUTO mode).
- Setting of Integration Period, selectable **from 5 sec to 60 min**

Press **ENTER** to confirm each setting, or **ESC** to exit from RECORDER CONFIG menu.

The pages of the "**RECORDER CONFIG**" can be schematised as follows:



To select **AUTOMATIC** start/stop mode, place the cursor on **MANU,** and select **AUTO** mode by using **F3** or **F4**.
The time and date are then displayed.

To revert to **MANUAL** mode, place the cursor on **AUTO** and select **MANU** mode using **F3** or **F4**

Use the multifunction keys **F1** and **F2** to position the cursor on the desired word and then use the multifunction keys **F3** or **F4** to modify the value.
Press **ENTER** to confirm and keep the settings made.
Press **ESC** to leave the Menu without modifying the existing parameters.

The following table shows the description of each function inside the RECORDER CONFIG menu:

Function	Description	Advised settings
START:MAN	The recording of all the selected parameters will start at 00 seconds after pressing **START/STOP**.	☺
STOP:MAN	The recording of all the selected parameters will be interrupted manually by pressing **START/STOP**.	☺
START:AUTO STOP:AUTO	The recording of all the selected values will be started / interrupted at the set dates and times. In order to start the recording the user will have to press START/STOP to set the instrument in Stand-by mode until the start date and time previously set.	
INT. PERIOD	The value of this parameter determines every how many seconds the values of **the selected parameters** will be memorised. Available choices: 5sec,10sec,30sec,1min, 2min 5min, 10min, 15min, 30min, 60min.	**15min** ☺

For messages displayed see **Error! Reference source not found.**

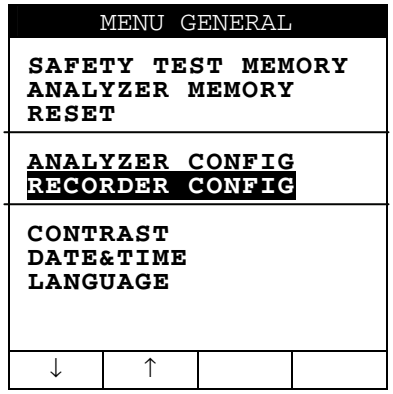
6.7.2. RECORDING: setting of Typical Configurations

The following "**Typical Configurations**" are selectable via RECORDER CONFIG menu:

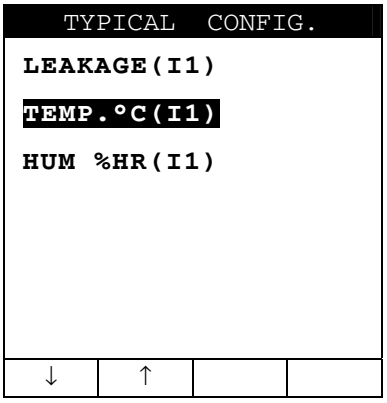
Standard Configuration	Description
LEAKAGE (I1)	Setting of measuring and recording mode of **Leakage current** on I1 channel.

To activate the above configuration, follow this procedure:

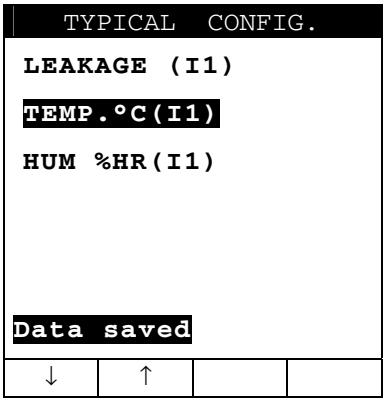
1. Turn the rotary switch to "**AUX**".
2. Press the **MENU** key. Use the **F1** key to display the screen below:



3. Press **MENU** key again. The instrument displays a screen as shown below (picture on the left). In this way it is possible to select the desired configuration on I1 channel with **F1** or **F2** key. NOTE that TEMP and HUMIDITY are not supported.



Configuration selection



Confirmation of configuration selection

4. Press **ENTER** key. The instrument displays the message "**Data saved**" for a while to confirm the configuration (see above picture on the right). The instrument will return to the measuring mode and you can start recording by pressing **START/STOP** key.

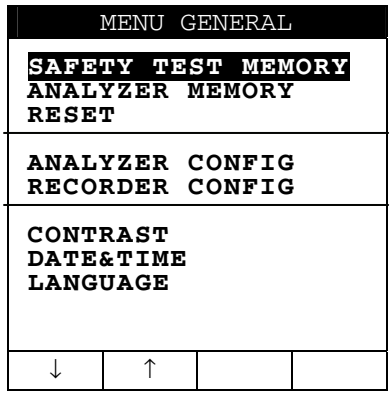
7. ANALYZER

This function allows the following operations:

- ✓ **Display in real time** the electrical parameters of a single phase system (with and without neutral wire) and the harmonic analysis of voltage and current.
- ✓ **Conduct a direct energy measurement** (without memorising).
- ✓ **Memorise** (pressing **SAVE** key) the sampled values of the parameters present at the instrument input generating an "Smp" record in the instrument memory. **It will be possible to analyse the memorised data ONLY by transferring the data to a PC.**
- ✓ **Record simultaneously** (pressing the **START** key after a proper setting): RMS values of voltage, current, corresponding harmonics, active, reactive and apparent powers, power factors and cosφ, active, reactive and apparent energies, voltage anomalies (voltage sag and surge) with 10ms resolution. **It will be possible to analyse the recorded data ONLY by transferring the data to a PC.**
- ✓ **Record simultaneously** (pressing the **START** key) values of Voltage and Current values coming from test leads and clamp, using "**Typical Configurations**" with pre-programmed parameters inside the meter (see paragraph 9.2).**It will be possible to analyse the recorded data ONLY by transferring the data to a PC.**

It is fundamental that the instrument settings correspond to the installation type under test and the accessories in use. We recommend that the user checks the instrument's settings before executing an ANALYSIS measurement.

Select the **ANALYZER** position on the rotary switch. On pressing the **MENU** key the following screen will be displayed:

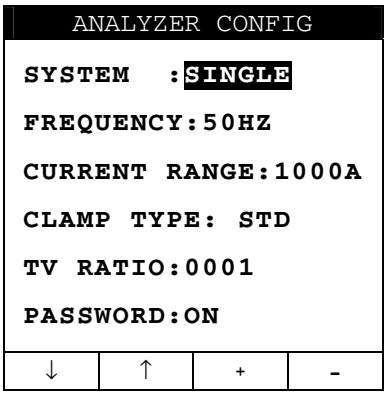


It is not possible to enter the **MENU** during a recording or a Real Time Energy measurement.

Generally, to check the instrument's settings you must check "ANALYZER CONFIG" and "RECORDER CONFIG" items.

7.1. BASIC SETTING: ANALYZER CONFIG

Place the rotary switch in the **ANALYZER** position, press the **MENU** key, use the **F1**/**F2** keys to select the **ANALYZER CONFIG** item and press the **ENTER** Key.
The following screen will be displayed:



These settings can be confirmed by pressing the **ENTER** key or cancelled by pressing the **ESC** key.

7.1.1. Type of electrical system under test

The parameter SYSTEM is fixed to "SINGLE" value as the VERITEST 2250 is only able to analyse a Single Phase system.

7.1.2. How to set the fundamental frequency

Position the cursor on the corresponding word by pressing the **F1**/ **F2** keys, and select the network frequency between the possible values **50Hz** and **60Hz** by pressing the multifunction keys **F3** and **F4**. This parameter is important ONLY if the input voltage is too low for the instrument to detect the frequency. (for example, only the clamps for the current measurement are connected). In this case the instrument generates an internal synchronism equal to the value of the set frequency.

7.1.3. How to set the current range

The value of this parameter **must always be equal to the full scale of the current clamp** used to take the measurement. If a multi-scale clamp is used, the value of this parameter must be equal to the scale selected on the clamp.
Set the desired value by pressing the multifunction keys **F3** and **F4**.

7.1.4. Clamp Type

The value of this parameter shows that standard clamps (**STD),** and flexible clamps **(flexINT and flexEXT)** may be used with this instrument.

7.1.5. How to set the value of the transformer voltage ratio (TV RATIO)

The instrument can also be interfaced with step-down transformers in the equipment under test. It can display the value of the voltages present on the primary winding of these transformers. To do this it will be necessary to set the value of the transformer winding ratio from 2:1 to 3000:1. The default is set at 1:1 for measurements of non transformer systems. Select “TV RATIO” in the ANALYZER CONFIG menu. Set the desired value by pressing the multifunction keys **F3** and **F4**.

7.1.6. How to enable / disable the password

The instrument is provided with password protection to avoid the accidental interruption of recording or energy measurements. Once a recording or a direct energy measurement has been started (with the option “PASSWORD” enabled), approximately 3 minutes from the last key press or switch rotation the **START/STOP** key is disabled. To stop the recording, it will be necessary to enter the password.
In order to enter the password (which is not changeable), press **START/STOP** then press the multifunction keys in the following sequence (within 10 seconds):

F1, **F4**, **F3**, **F2**

If you wait more than about 10 seconds, the display will return to the meter mode and the instrument will continue recording. If you enter the wrong password, the message “ERROR PASSWORD” will be displayed under “PASSWORD”. After a few seconds the display will return to meter mode and the instrument will continue recording. In order to enable/disable this option the correct password will have to be entered. The display will then return to meter mode, and **START/STOP** will have to be pressed again to stop the recording. You will then need to re-enter the “ANALYZER CONFIG” menu and scroll up or down to the item “PASSWORD: ON” using the multifunction keys **F1** and **F2.** Then turn the password off by pressing the multifunction keys **F3** and **F4**.

7.2. BASIC SETTING: RECORDER CONFIG

Place the rotary switch in the **ANALYSER** position, press the **MENU** key, use the **F1**/**F2** keys select the **RECORDER CONFIG** and press the **ENTER** Key.
This option allows you to check and modify the recording parameters, and the selected parameters (up to a maximum of 62 + Frequency). If the number of selected values exceeds 63 the message "too many param" will be displayed. The RECORDER CONFIG mode is divided into 4 separate sub-screens:

- ✓ 1st screen: This screen allows you to set the START/STOP mode (AUTO or MANUAL), the START and STOP time if AUTO mode is selected, the Integration Period value, the Enabling/Disabling of Voltage Anomalies detection, the Enabling/Disabling of Harmonics detection. Press **ENTER** to confirm the settings and go to the next screen.
  Press **ESC** to leave the menu without modifying the existing parameters.

- ✓ 2nd screen: This screen is devoted to the settings relevant to the **VOLTAGE** recording.
  Press **ENTER** to confirm the settings and go to the next page.
  Press **ESC** to leave this screen without modifying the existing parameters.
  From this page you can enter the sub-screen “Harmonics” by pressing the **F1/F2** keys to select ‘HARM REC’ and then the **F3** key. You can then select the voltage harmonics to be recorded.
  Press **ENTER** to confirm the settings and leave the “Harmonics” menu.
  Press **ESC** to leave the "Harmonics" menu without modifying the existing parameters.

- ✓ 3rd screen: This screen is devoted to the settings relevant to the **CURRENT** recording.
  Press **ENTER** to confirm the settings and go to the next screen.
  Press **ESC** to leave this screen without modifying the existing parameters.
  From this screen you can enter the sub-screen “Harmonics” by pressing the **F1/F2** keys to select ‘HARM REC’ and then the **F3** key. You can then select the current harmonics to be recorded.
  Press **ENTER** to confirm the settings and leave the “Harmonics" menu.
  Press **ESC** to leave the "Harmonics" without modifying the existing parameters.

- ✓ 4th screen: Menu composed of two sub-screens devoted to the selection of the **POWERS and ENERGIES** to be recorded. From this screen you can enter the sub-screen “POWER” and “ENERGY” by pressing the **F1/F2** keys to select ‘POWER’ or ‘ENERGY’ and then the **F3** key. You can then select the parameters to be recorded.
  When selecting the active powers for the recording, the corresponding active energies will be automatically selected.
  When selecting the reactive powers for the recording, the corresponding reactive energies will be selected.
  Press **ENTER** to leave this screen confirming the modifications made.
  Press **ESC** to leave the "Menu" without modifying the existing parameters.

The various screens of the "**RECORDER CONFIG**" can be schematised as follows:

MENU

RECORDER CONFIG

START
MANU

STOP
MANU

INT. PERIOD: 15min
HARM REC: ON
ANOM REC: ON

↓ ↑ + -

1st screen of the RECORDER CONFIG MENU

To select **AUTOMATIC** start/stop mode, place the cursor on **MANU,** and select **AUTO** mode by using **F3** or **F4**. The time and date are then displayed.

To revert to **MANUAL** mode, place the cursor on **AUTO** and select **MANU** mode using **F3** or **F4**

Use the multifunction keys **F1** and **F2** to position the cursor on the desired word and then use the multifunction keys **F3** or **F4** to modify the value.
Press **ENTER** to confirm and keep the settings made.
Press **ESC** to leave the Menu without modifying the existing parameters.

ENTER

Use the multifunction keys **F1**, **F2** to position the cursor on the desired symbol and use the multifunction keys **F3** / **F4** to select / deselect the desired parameter (selected if marked in black).
Press **ENTER** to confirm and leave the Menu keeping the settings made.
Press **ESC** to leave this page without modifying the existing parameters.

RECORDER CONFIG

VOLTAGE:
V1

HARM. REC:Pg (ON)

Vref P-N: 230V
LIM+: 06% (243.8V)
LIM-: 10% (207.0V)

↓ ↑ + -

Example of 2nd screen with ANOM flag enabled

If you want to change Voltage Harm, place the cursor on the corresponding "Pg" symbol then Press **F3**

RECORDER CONFIG

VOLTAGE HARMONICS

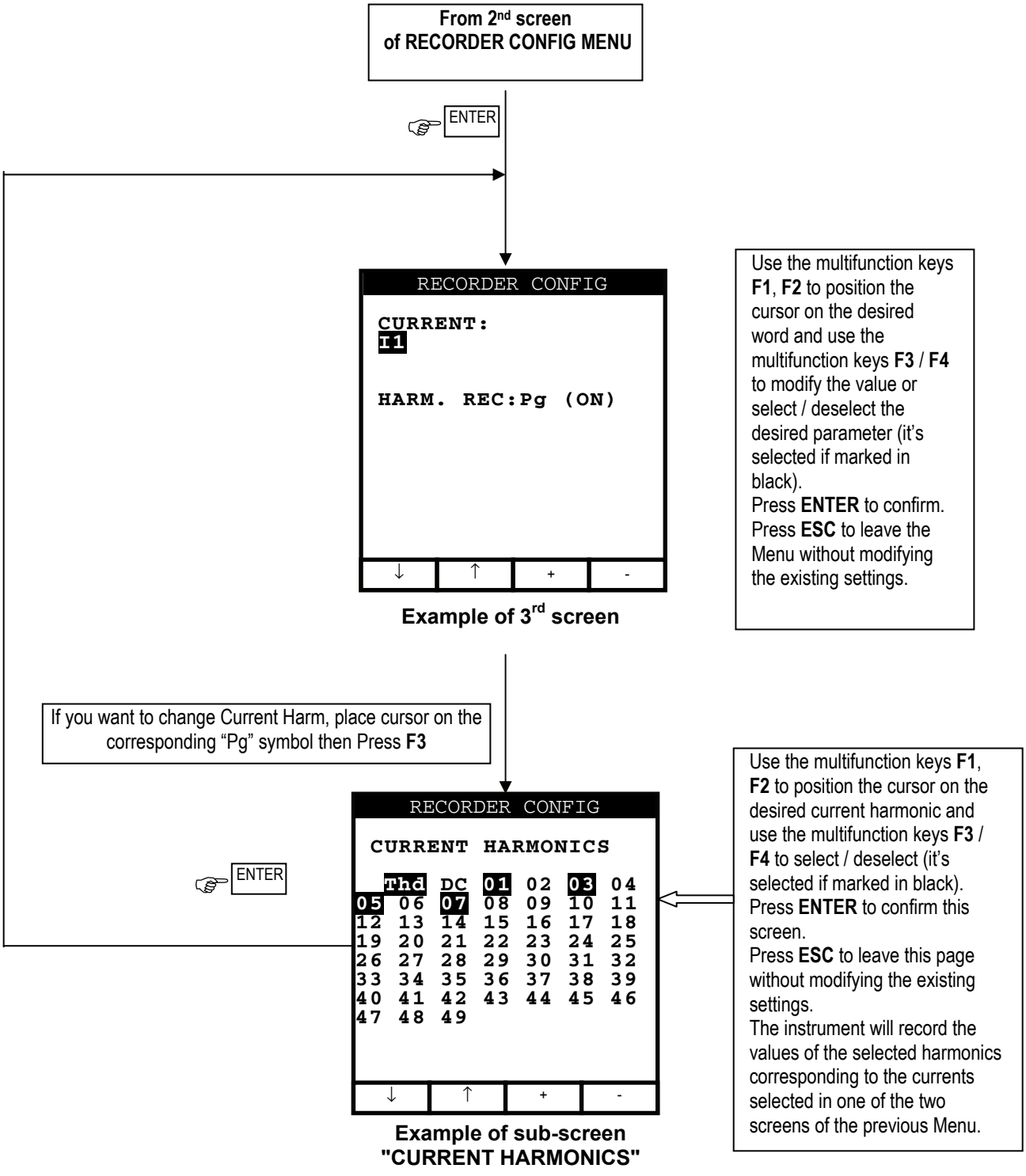
Thd DC 01 02 03 04
05 06 07 08 09 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 29 30 31 32
33 34 35 36 37 38 39
40 41 42 43 44 45 46
47 48 49

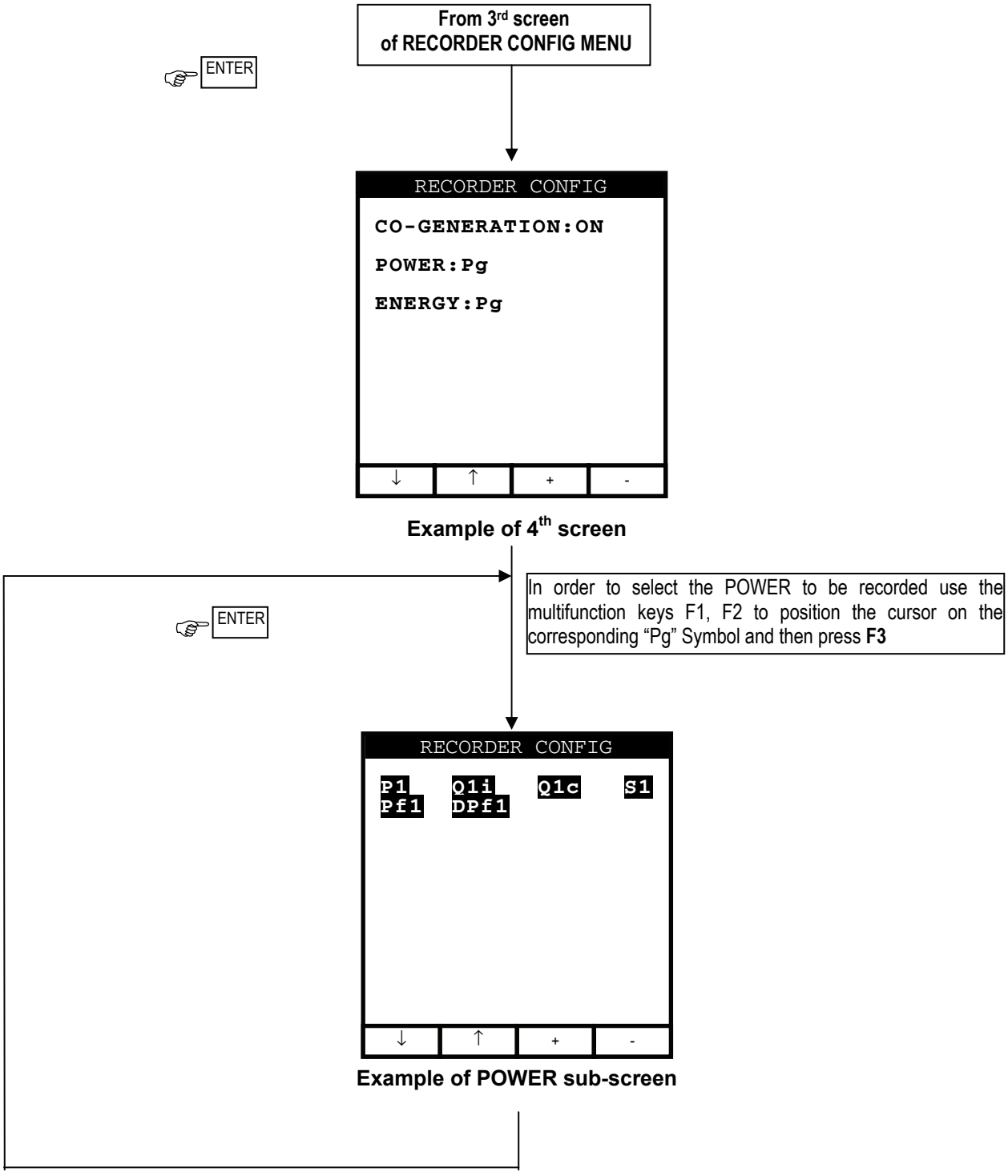
↓ ↑ + -

ENTER

Example of sub-screen "VOLTAGE HARMONICS"

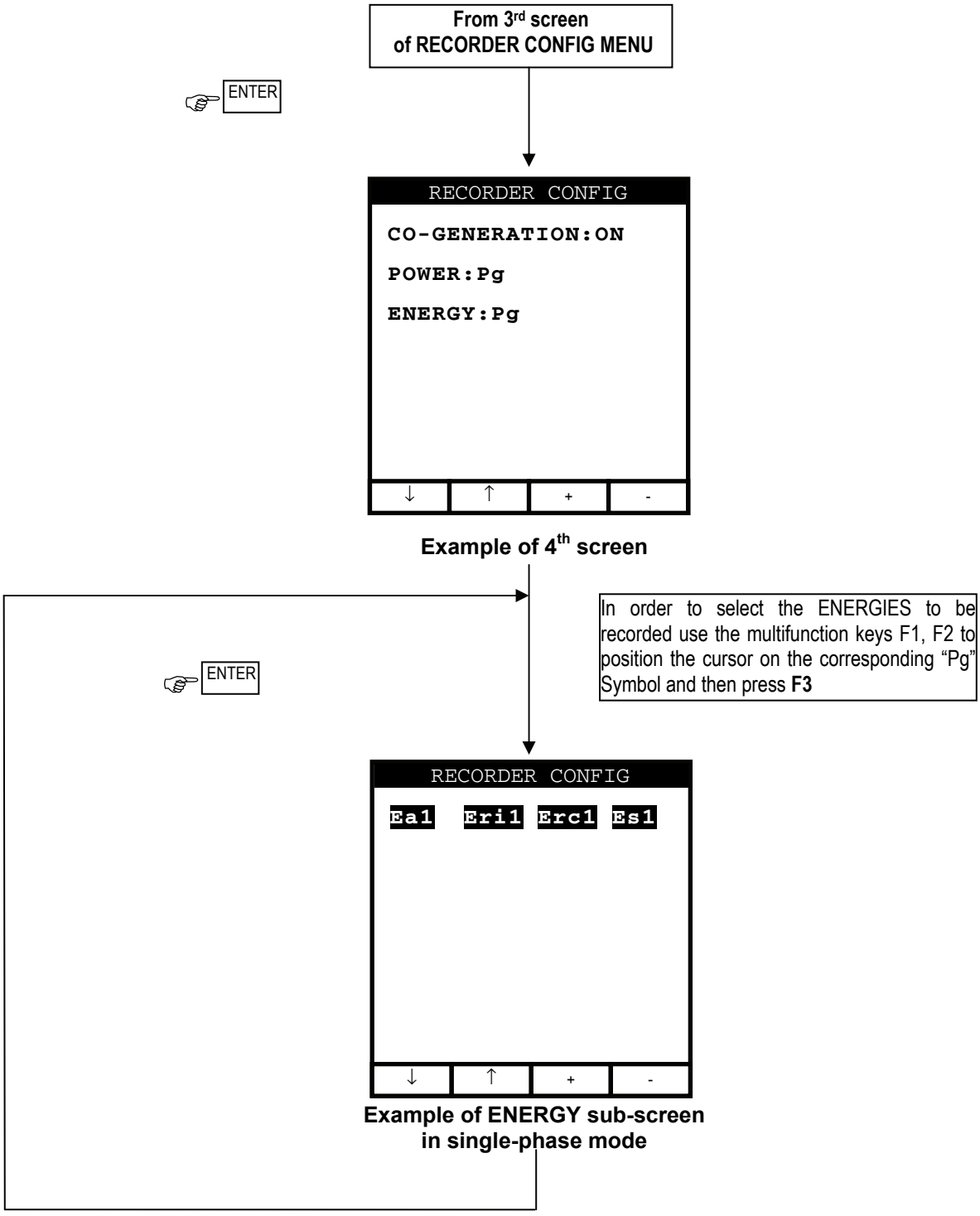
Use the multifunction keys **F1**, **F2** to position the cursor on the desired voltage harmonic and use the multifunction keys **F3** / **F4** to select / deselect (selected if highlighted in black).
Press **ENTER** to confirm this screen.
Press **ESC** to leave the Menu without modifying the existing settings.
The instrument will record the values of the selected harmonics corresponding to the voltage selected in one of the two screens of the previous Menu.


From 2nd screen
of RECORDER CONFIG MENU
ENTER
RECORDER CONFIG
CURRENT:
I1
HARM. REC:Pg (ON)
↓
↑
+
-
Use the multifunction keys F1, F2 to position the cursor on the desired word and use the multifunction keys F3 / F4 to modify the value or select / deselect the desired parameter (it's selected if marked in black).
Press ENTER to confirm.
Press ESC to leave the Menu without modifying the existing settings.
Example of 3rd screen
If you want to change Current Harm, place cursor on the corresponding "Pg" symbol then Press F3
ENTER
RECORDER CONFIG
CURRENT HARMONICS
Thd DC 01 02 03 04
05 06 07 08 09 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 29 30 31 32
33 34 35 36 37 38 39
40 41 42 43 44 45 46
47 48 49
↓
↑
+
-
Use the multifunction keys F1, F2 to position the cursor on the desired current harmonic and use the multifunction keys F3 / F4 to select / deselect (it's selected if marked in black).
Press ENTER to confirm this screen.
Press ESC to leave this page without modifying the existing settings.
The instrument will record the values of the selected harmonics corresponding to the currents selected in one of the two screens of the previous Menu.
Example of sub-screen
"CURRENT HARMONICS"



WARNING

- When selecting the active power for the recording, the corresponding active energy will be automatically selected.
- When selecting the reactive powers for the recording, the corresponding reactive energies will be selected.



WARNING

- When selecting the active energy for the recording, the corresponding active power will be automatically selected.
- When selecting the reactive energies for the recording, the corresponding reactive powers will be selected.

Symbols	Description	Advised settings
START:MAN	The recording of all the selected parameters will start at 00 seconds after pressing **START/STOP** (see chapter 9.1).	☺
STOP:MAN	The recording of all the selected parameters will be interrupted manually by pressing **START/STOP** (see chapter 9.1).	☺
START:AUTO STOP:AUTO	The recording of all the selected values will be started / interrupted at the set dates and times. In order to start the recording the user will have to press START/STOP to set the instrument in stand-by mode until the start date and time previously set (see chapter 9.1).	
INT. PERIOD	The value of this parameter determines how many seconds will elapse before the values of **all the selected parameters** will be memorised. Available choices: 5sec,10sec,30sec,1min,2min,5min,10min,15min,30min,60min.	**15min** ☺
HARM REC.	**ON =** the instrument will record the values of the selected **voltage and current harmonics**.	☺
	OFF = the instrument **will not record** any voltage or current harmonic selected	
ANOM REC.	**ON =** the instrument will record voltage anomalies (voltage sag and surge)	☺
	OFF = the instrument **will not record** any voltage sag and surge	
V1	Voltage RMS value	☺ **V1**
THD, DC, 01...49	Voltage Total Harmonic Distortion, DC Component, 01 to 49 harmonics respectively.	☺ **THD,01,03,05,07**
Vref (Only if ANOM. REC flag has been set ON)	RMS reference value for voltage used in voltage anomalies detection (voltage sag and surge). The reference is: a) Voltage Phase to Neutral for single phase and 4 wire three phase system. b) Voltage Phase to Phase for 3 wire three phase system.	☺ Single phase: **230V** 3 Phase system: 3 wires: **400V** 4 wires **230V**
LIM+, LIM- (Only if ANOM. REC flag has been set ON)	High and Low Voltage Percent threshold used in voltage anomalies detection (voltage sag and surge). These parameters can be adjusted in range 3% ÷ 30% (step 1%). Example: Three Phase System 4 wire. Vref = 230, LIM+= 6%, LIM-=10% => High Lim = 243.8V, Low Lim = 207.0V The instrument will detect a voltage anomaly if the RMS voltage values (calculated every 10ms) are beyond the above calculated thresholds	☺ **+6% / -10%**
I1	Current RMS value.	☺ **I1**
THD, DC, 01..49	Current Total Harmonic Distortion, DC Component, 01 to 49 harmonics respectively	☺ **THD,01,03,05,07**

CO-GENERATION	ON = the instrument is able to manage CO-GENERATION of electrical equipment (that is, the equipment under test is able to generate energy besides absorbing it). Accordingly, the instrument will record the powers and energies both absorbed and generated. **If this flag is enabled the maximum number of parameters which can be selected decrease to 38.**	
	OFF = the instrument will record ONLY the powers and energies absorbed.	☺
P1	Active Power	☺ **P1**
Q1i	Inductive Reactive Power	☺ **Q1i Q1c**
Q1c	Capacitive Reactive Power	
S1	Apparent Power	☺ **S1**
Pf1	Power factor	☺ **Pf1 dPf1**
DPft1	cosφ	
Ea1	Active energy	☺ **Ea1**
Eri1	Inductive reactive energy	☺ **Eri1 Erc1**
Erc1	Capacitive reactive energy	

The value of the network frequency is automatically selected if the voltage is selected.

The symbols "**i**" and "**c**" stand for reactive powers (Q), power factors (Pf) and cosφ (dpf) inductive and capacitive respectively.

When selecting a power factor (Pf) or a cosφ (dPf) for recording the inductive value and the capacitive value will be recorded separately.

For messages displayed see **Error! Reference source not found.**

7.3. ANALYZER FUNCTIONS

F3
F4

☞ For basic use, the main working mode of the ANALYZER mode can be selected by means of **F3** and **F4**.

☞ "**VOLTAGE**" function: to be used to display **voltage and corresponding harmonics** (see paragraph 7.4)

☞ "**CURRENT**" function: to be used to display **current and corresponding harmonics** (see paragraph 7.5)

☞ "**POWER**" function: to be used to display of **all the parameters measurable by the instrument**: voltage, current, active, reactive and apparent power, power factor, cosφ and energy (see paragraph 7.6)

☞ "**ENERGY**" function: to be used to display **active, reactive and apparent power, power factor, cosφ and energy** (see paragraph 7.7)

More practically, we may schematise the correct procedure for the **ANALYZER** function as follows:

1. Check, and if required, modify the "ANALYZER CONFIG" settings of the instrument
2. Using **F3** and **F4**, select the type of measurement to be taken
3. Connect the instrument to the electrical system to be tested
4. Evaluate the values of the parameters under test
5. If you want to record:
   a) Decide what to record
   b) Press **MENU** and check if the "RECORDER CONFIG" settings meet your requirements.
   c) Consider Typical Configuration recording (see paragraph 9.2).
6. Connect the External Power Supply MARVR2250PSU (optional)
7. Start the recording by pressing START/STOP.

7.4. "VOLTAGE" FUNCTION

✓ This function permits you to display in real time the RMS value of AC/DC voltage, the peak, the Thd value, the waveform and the harmonic spectrum of the voltage.

7.4.1. Symbols

The VOLTAGE position has three working modes:

✓ METER
✓ WAVE
✓ HARM

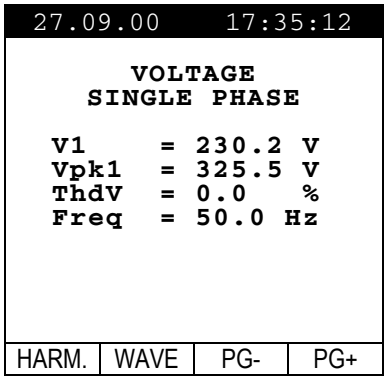
These modes will be described in detail in the next paragraphs.
The symbols used are described below:

Symbol	Description
V1	Voltage RMS value
Vpk1	Peak value of the voltage
h01 - h49	Harmonic 01 - Harmonic 49.
ThdV	Factor of total harmonic distortion of the voltage.
freq	Network frequency

Table 1: Symbols used in the **VOLTAGE** function

7.4.2. "METER" mode

In this mode the instrument shows a screen similar to this, according to the settings made as per paragraph 7.1.



Example of screen

The symbols used are described in Table.1

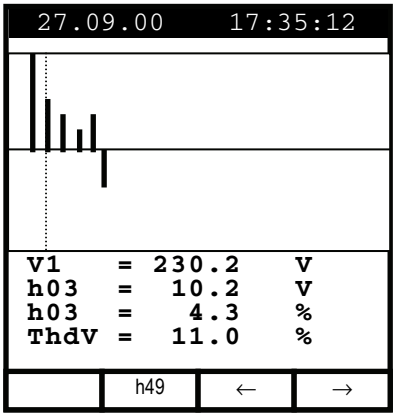
For messages displayed see **Error! Reference source not found.**

The following keys are enabled:

- ☞ **F1**: to select the "HARMONIC" mode (see paragraph 7.4.3).
- ☞ **F2**: to select the "WAVE" mode (see paragraph 7.4.4).
- ☞ **F3/F4**: to select the previous/next function respectively.
- ☞ **SAVE**: to save a record of “Smp” type in instrument memory (see paragraph 8.2) containing the instantaneous values of voltage and current present on the instrument inputs. This function is disabled during a recording.
- ☞ **ENTER/HOLD**: to enable/disable the HOLD function of the displayed data. All the previous functions remain available. When the HOLD function is enabled, the word HOLD is displayed. When this function is enabled it is not possible to record or take an energy measurement. This function is disabled during a recording or an energy measurement.
- ☞ **MENU**: to enter in the **MENU** mode and change the instrument settings (see paragraph 7.1 and 7.2). It is not possible to enter the configuration MENU during a recording or an energy measurement.
- ☞ **START/STOP**: to record the **selected parameters** according to the instrument’s settings (see chapter 9).

7.4.3. "HARM" mode

On selecting the HARM mode a screen similar to this will be displayed, according to the settings made as per paragraph 7.1. The screen shows the harmonics of the voltage.



Example of screen

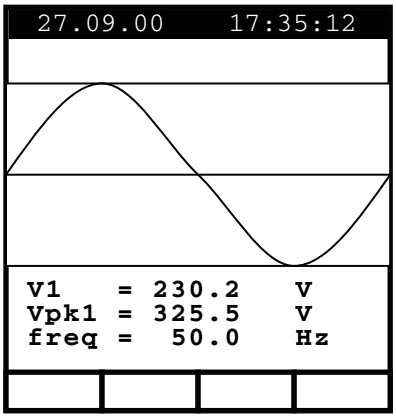
The symbols used are described in Table 1. For messages displayed see **Error! Reference source not found.**. The displayed histograms represent the harmonic content of the voltage under test. The value of the first harmonic h01 (fundamental at 50Hz) is not represented in scale along with the other harmonics, in order to maximize the display. In case voltage and current are connected to the instrument inputs, negative values of the harmonics (represented under the horizontal axis), indicate that such voltage harmonics are "generated" by the load.

The following keys are enabled:

- ☞ **F3**, **F4**: to move the cursor left and right to select a harmonic. At the same time the values relevant to the order number of the selected harmonic, and to the corresponding absolute and relative values (calculated on the basis of the fundamental) are updated.
- ☞ **F2**: to display the page of the harmonics h01 ÷ h24 (symbol **h24**) or that of the harmonics h25 ÷ h49 (symbol **h49**).
- ☞ **ESC**: to return to METER mode (see paragraph 7.4.2).
- ☞ **SAVE**: to save a record of "Smp" type in instrument memory (see paragraph 8.2) and the instantaneous values of voltage and current present on the instrument inputs. This function is disabled during a recording.
- ☞ **ENTER/HOLD**: to enable/disable the HOLD function of the displayed data. All the previous functions remain available. When the HOLD function is enabled, the word HOLD is displayed. When this function is enabled it is not possible to record or take an energy measurement. This function is disabled during a recording or an energy measurement.
- ☞ **MENU**: to enter the **MENU** mode and change the instrument settings (see paragraph 7.1 and 7.2). It is not possible to enter the configuration MENU during a recording or an energy measurement.
- ☞ **START/STOP**: to record **selected parameters** according to the instrument's settings (see chapter 9).

7.4.4. "WAVE" mode

On selecting the WAVE mode, a screen similar to this will be displayed, according to the settings made as per paragraph 7.1. The screen shows the waveform of the voltage.



Example of screen

The symbols used are described in Table 1. For messages displayed see **Error! Reference source not found.**.

The following keys are enabled:

- ☞ **ESC**: to return to METER mode (see paragraph 7.4.2).
- ☞ **SAVE**: to save a record of “Smp” type in instrument memory (see paragraph 8.2) and the instantaneous values of voltage and current present on the instrument inputs. This function is disabled during a recording.
- ☞ **ENTER/HOLD**: to enable/disable the HOLD function of the displayed data. All the previous functions remain available. When the HOLD function is enabled, the word HOLD is displayed. When this function is enabled it is not possible to record or take an energy measurement. This function is disabled during a recording or an energy measurement.
- ☞ **MENU**: to enter in the **MENU** mode and change the instrument settings (see paragraph 7.1 and 7.2). It is not possible to enter the configuration MENU during a recording or an energy measurement.
- ☞ **START/STOP**: to record **selected parameters** according to the instrument’s settings (see chapter 9).

7.5. "CURRENT" FUNCTION

This function displays in real time the RMS value of AC/DC current, the peak, the ThdI value, the waveform and the harmonic spectrum of the current.

7.5.1. Symbols

The CURRENT position has three working modes:

- ✓ METER
- ✓ WAVE
- ✓ HARM

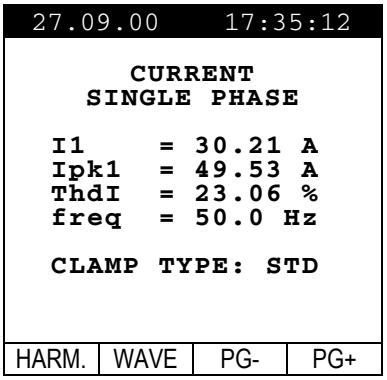
These modes will be described in detail in the next paragraphs.
The symbols used are described below:

Symbol	Description
I1	Current RMS value
Ipk1	Peak value of the current
h01 - h49	Harmonic 01 - harmonic 49.
ThdI	Total harmonic distortion factor of the current.
freq	Network frequency

Table 2: Symbols used in the **CURRENT** function

7.5.2. “METER" mode

In this mode the instrument shows a screen similar to this, according to the settings made as per paragraph 7.1.



Example of screen

The symbols used are described in Table 2.

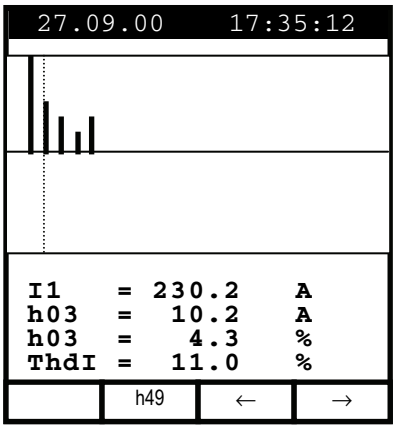
For messages displayed see **Error! Reference source not found.**.

The following keys are enabled:

- **F1**: to select the "HARMONIC" mode (see paragraph 7.5.3).
- **F2**: to select the "WAVE" mode (see paragraph 7.5.4).
- **F3/F4**: to select the previous/next function respectively.
- **SAVE**: to save a record of “Smp” type in instrument memory, (see paragraph 8.2) containing the instantaneous values of voltage and current present on the instrument inputs. This function is disabled during a recording.
- **ENTER/HOLD**: to enable/disable the HOLD function of the displayed data. All the previous functions remain available. When the HOLD function is enabled, the word HOLD is displayed. When this function is enabled it is not possible to record or take an energy measurement. This function is disabled during a recording or an energy measurement.
- **MENU**: to enter the **MENU** mode and change the instrument settings (see paragraph 7.1 and 7.2). It is not possible to enter the configuration MENU during a recording or an energy measurement.
- **START/STOP**: to record **selected parameters** according to the instrument’s settings (see chapter 9).

7.5.3. “HARM" mode

On selecting the HARM mode a screen similar to this will be displayed according to the settings made as per paragraph 7.1. The screen shows the harmonics of the current.



Example of screen

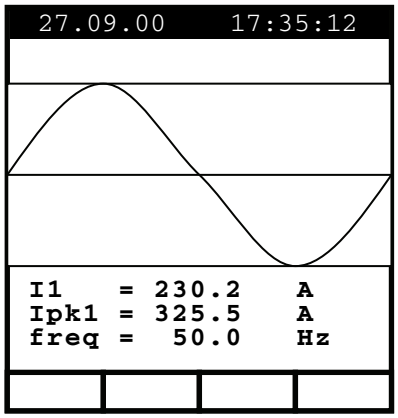
The symbols used are described in Table 2. For messages displayed see **Error! Reference source not found.**. The displayed histograms represent the harmonic content of the current under test. The value of the first harmonic h01 (primary at 50Hz) is not represented in scale along with the other harmonics in order to maximise the display. In case both voltage and current are connected to the instrument inputs, negative values (represented under the horizontal axis), indicate that such current harmonics are “generated” by the load.

The following keys are enabled:

- ☞ **F3**, **F4**: to move the cursor left and right to select a harmonic. At the same time the values relevant to the order number of the selected harmonic, and to the corresponding absolute and relative values (calculated on the basis of the fundamental) are updated.
- ☞ **F2**: to display the page of the harmonics h01 - h24 (**h24** symbol) or that of the harmonics h25 - h49 (**h49** symbol).
- ☞ **ESC**: to return to METER mode (see paragraph 7.5.2)
- ☞ **SAVE**: to store a record of “Smp” type in instrument memory (see paragraph 8.2) and the instantaneous values of voltage and current present on the instrument inputs. This function is disabled during a recording.
- ☞ **ENTER/HOLD**: to enable/disable the HOLD function of the displayed data. All the previous functions remain available. When the HOLD function is enabled, the word HOLD is displayed. When this function is enabled it is not possible to record or take an energy measurement. This function is disabled during a recording or an energy measurement.
- ☞ **MENU**: to enter the **MENU** mode and change the instrument settings (see paragraph 7.1 and 7.2). It is not possible to enter the configuration MENU during a recording or an energy measurement.
- ☞ **START/STOP**: to record **selected parameters** according to the instrument’s settings (see chapter 9).

7.5.4. "WAVE" mode

On selecting the WAVE mode a screen similar to this will be displayed according to the settings made as per paragraph 7.1. The screen shows the waveform of the current.



Example of screen

The symbols used are described in Table 2.

For messages displayed see **Error! Reference source not found.**.

The following keys are enabled:

- ☞ **ESC**: to return to METER mode (see paragraph 7.5.2).
- ☞ **SAVE**: to save a record of “Smp” type in instrument memory (see paragraph 8.2) containing the instantaneous values of voltage and current present on the instrument inputs. This function is disabled during a recording.
- ☞ **ENTER/HOLD**: to enable/disable the HOLD function of the displayed data. All the previous functions remain available. When the HOLD function is enabled, the word HOLD is displayed. When this function is enabled it is not possible to record or take an energy measurement. This function is disabled during a recording or an energy measurement.
- ☞ **MENU**: to enter the **MENU** mode and change the instrument settings (see paragraph 7.1 and 7.2). It is not possible to enter the configuration MENU during a recording or an energy measurement.
- ☞ **START/STOP**: to record **selected parameters** according to the instrument’s settings (see chapter 9).

7.6. "POWER" FUNCTION

This function permits a display in real time of the RMS value of AC/DC voltage, the peak and ThdV value and the waveform of the voltage, the RMS value of AC/DC currents, the peak, Thdl value and the waveform of the current. Furthermore, the instrument calculates and displays the value of the active, reactive and apparent power and the value of the power factors and cosφ.

7.6.1. Symbols

The position POWER has two working modes:

- ✓ METER
- ✓ WAVE

For voltage and current harmonics see paragraphs 7.4.3 and 7.5.3 respectively.

These modes will be described in detail in the next paragraphs.
The symbols used are described below:

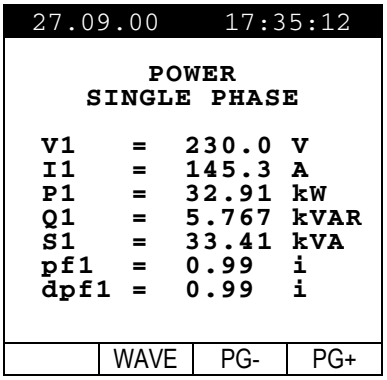
Symbol	Description
V1	Voltage RMS value
freq	Network frequency
I1	Current RMS value
P1	Active power
Q1	Reactive power
S1	Apparent power
Pf1	Power factor
dpf1	cosφ

Table 3: Symbols used in the **POWER** function

The symbols "**i**" and "**c**" stand for reactive powers (Q), power factors (Pf) and cosφ (dpf) respectively inductive and capacitive.

7.6.2. "METER" mode

In this mode the instrument shows a screen similar to this, according to the settings made as per paragraph 7.1.



Example of screen

The symbols used are described in Table 3.

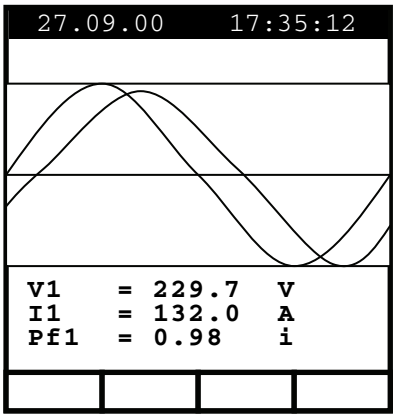
For messages displayed see **Error! Reference source not found.**

The following keys are enabled:

- ☞ **F2**: to select the "WAVE" mode (see paragraph 7.6.3).
- ☞ **F3/F4**: to select the previous/next function respectively.
- ☞ **SAVE**: to save a record of “Smp” type in instrument memory (see paragraph 8.2) and the instantaneous values of voltage and current present on the instrument inputs. This function is disabled during a recording.
- ☞ **ENTER/HOLD**: to enable/disable the HOLD function of the displayed data. All the previous functions remain available. When the HOLD function is enabled, the word HOLD is displayed. When this function is enabled it is not possible to record or take an energy measurement. This function is disabled during a recording or an energy measurement.
- ☞ **MENU**: to enter the **MENU** mode and change the instrument settings (see paragraph 7.1 and 7.2). It is not possible to enter the configuration MENU during a recording or an energy measurement.
- ☞ **START/STOP**: to record **selected parameters** according to the instrument’s settings (see chapter 9).

7.6.3. "WAVE" mode

Selecting the WAVE mode a screen similar to this will be displayed according to the settings made as per paragraph 7.1. The screen shows the waveform of the current and the voltage.



Example of screen

The symbols used are described in Table 3.

For messages displayed see appendix 1 – MESSAGES DISPLAYED.

The following keys are enabled:

- ☞ **ESC**: to return to METER mode (see paragraph 7.6.2).
- ☞ **SAVE**: to save in the instrument memory a record of “Smp” type (see paragraph 8.2) containing the instantaneous values of voltage and current present on the instrument inputs. This function is disabled during a recording.
- ☞ **ENTER/HOLD**: to enable/disable the HOLD function (updating interruption) of the displayed data. All the previous functions remain available. When the HOLD function is enabled, the word HOLD is displayed. When this function is enabled it is not possible to record or take an energy measurement. This function is disabled during a recording or an energy measurement.
- ☞ **MENU**: to enter in the **MENU** mode and change the instrument settings (see paragraph 7.1 and 7.2). It is not possible to enter the configuration MENU during a recording or an energy measurement.
- ☞ **START/STOP**: to record **selected parameters** according to the instrument’s settings (see chapter 9).

7.7. "ENERGY" FUNCTION

This function displays the values of the active powers, capacitive and inductive reactive powers, power factor and cosφ. Furthermore, the instrument is able to measure directly the values of the energies and the values of the capacitive and inductive reactive energies (see 7.7.2)

7.7.1. Symbols

The position ENERGY has only one working mode:

- ✓ METER

This mode will be described in detail in the next paragraphs.
The symbols used are described below:

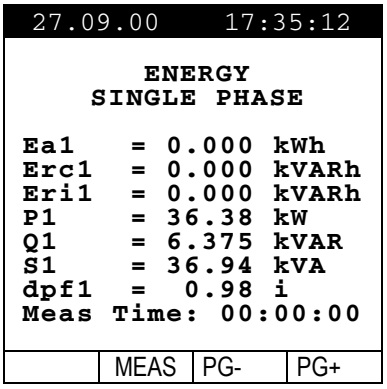
Symbol	Description
P1	Active power
Q1	Reactive power
S1	Apparent power
pf1	Power factor
dpf1	cosφ
Ea1	Active energy
Eri1	Inductive reactive Energy
Erc1	Capacitive reactive Energy

Table 4: Symbols used in the **ENERGY** function

The symbols "**i**" and "**c**" stand for reactive powers (Q) and energies (Er) inductive and capacitive respectively.

7.7.2. "METER" mode

In this mode the instrument shows a screen similar to this, according to the settings made as per paragraph 7.1.



Example of screen

The symbols used are described in Table 4.

For messages displayed see **Error! Reference source not found.**.

The following keys are enabled:

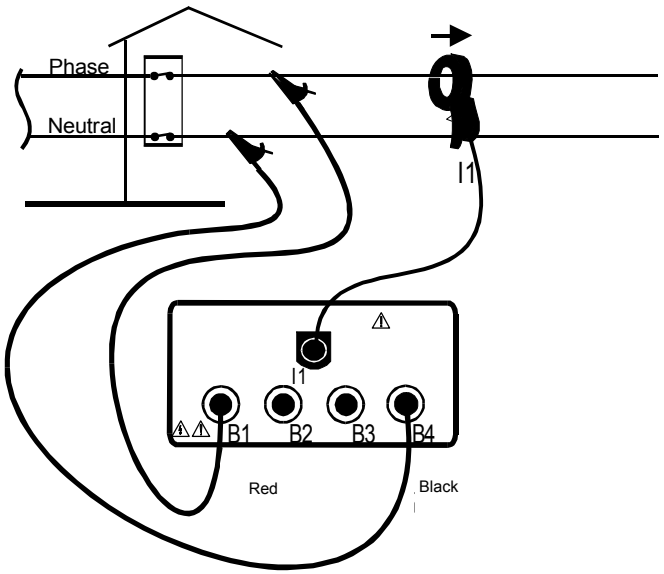
- ☞ **F2**: to start / stop a **direct energy measurement**. The energy counters will start increasing proportionally to the active power absorbed by the load.
  The results obtained cannot be memorised.
  If the active power is negative the counters will not increase.
- ☞ **F3/F4**: to pass to previous/next function respectively.
- ☞ **SAVE**: to save a record of “Smp” type in instrument memory (see paragraph 8.2) containing the instantaneous values of voltage and current present on the instrument inputs. This function is disabled during a recording.
- ☞ **ENTER/HOLD**: to enable/disable the HOLD function of the displayed data. All the previous functions remain available. When the HOLD function is enabled, the word HOLD is displayed. When this function is enabled it is not possible to record or take an energy measurement. This function is disabled during a recording or an energy measurement.
- ☞ **MENU**: to enter the **MENU** mode and change the instrument settings (see paragraph 7.1 and 7.2). It is not possible to enter the configuration MENU during a recording or an energy measurement.
- ☞ **START/STOP**: to record **selected parameters** according to the instrument’s settings (see chapter 9).

7.8. MEASURING PROCEDURES

7.8.1. Using the Instrument in a Single Phase System

WARNING

The maximum voltage between B1 and B4 inputs is 600 V~ (CATII) / 350V~ phase – earth or 600V~ (CATIII) / 300 V~ phase to earth.
Do not measure voltages exceeding the limits prescribed by this manual. Should you exceed the voltage limits you could damage the instrument and/or its components and endanger your safety.



Instrument connection in a single-phase system

WARNING

If possible, switch off the supply before connecting the instrument to the electrical equipment to be tested

1. Check, and if needed modify, the basic settings of the instrument (see paragraphs 7.1 and 7.2).
2. Select the working mode corresponding to the type of analysis desired. In case of doubt select the **POWER** mode (see paragraph 7.6).
3. Connect to the phase and neutral wires as shown in the picture above
4. If you want to measure current and power, connect the clamp meter to the phase conductor respecting the specifications shown on the clamp and the connections shown in the picture.
   In case of doubt select the **POWER** mode and check if the active power P is positive. If it is negative, remove current transducer from the wire and reconnect it so the transducer label faces in the opposite direction.
5. Apply voltage to the electrical equipment under test (if previously shut off for the instrument connection).
6. The values of the available electrical parameters will be displayed on the instrument. For further details see the paragraph relevant to the switch position selected.
7. You can press **HOLD** to stop updating the displayed values.
8. You can press **SAVE** to save the displayed values (see paragraph 8.2).

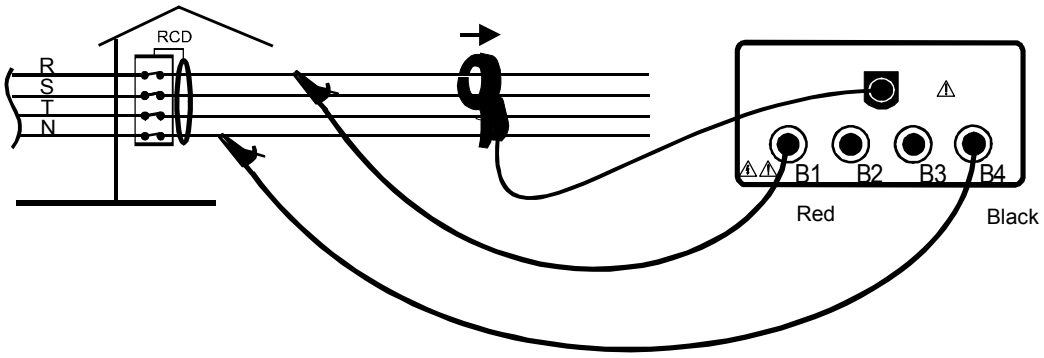
9. If you want to record:
   a) Check, and if needed modify, the values of the basic parameters (see paragraphs 7.1 and 7.2).
   b) Check, and if needed modify, the recording parameters by pressing **MENU** (see the paragraph corresponding to the position of the rotary switch).
   c) To start the recording press **START** (see chapter 6).

7.8.2. Using the Instrument in a Three Phase System

WARNING

The maximum voltage between B1 and B4 inputs is 600 V~ (CATII) / 350V~ phase – earth or 600V~ (CATIII) / 300 V~ phase to earth.
Do not measure voltages exceeding the limits prescribed by this manual. Should you exceed the voltage limits you could damage the instrument and/or its components and endanger your safety.

The instrument is a single phase device. To analyse a three phase system it is necessary to repeat the single phase analysis described above for each phase.



Instrument connection in a three-phase system

The Three Phase power values are given by:

Total Active Power = Pt = P1 + P2 + P3

Total Reactive Power = Qt= Q1 + Q2 + Q3

Total Apparent Power = St = $\sqrt{(Pt^2 + Qt^2)}$

8. SAVING RESULTS

The **SAVE** button can be used to store the displayed results related to the rotary switch position:

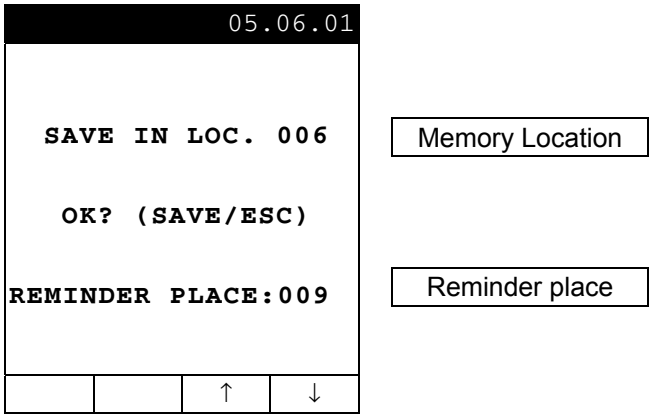
- ✓ For SAFETY TEST and for AUX rotary switch position: pressing this key will store the displayed result, generating a record in the SAFETY TEST MEMORY (see paragraph 10.1)
- ✓ ANALYZER rotary switch position: pressing this key will store the displayed result generating an "Smp" record in the ANALYZER MEMORY (see paragraph 10.2)

Please note that saving results is different from recording.

8.1. SAVING SAFETY TEST RESULTS

After a SAFETY TEST (function LOWΩ, MΩ, RCD, LOOP, Phase sequence, EARTH) or during a real time measurement in AUX position, the user can press the SAVE button to store the displayed result.

☞ The REMINDER PLACE parameter is not related to the measurement order number and can help to remind the user the place where the measurement was performed.



The following keys are available:

- ☞ **F3**, **F4**: to change the REMINDER PLACE number
- ☞ **SAVE**: to store the test result associated with the REMINDER PLACE
- ☞ **ESC**: to quit this mode without saving.

8.2. SAVING DISPLAYED VALUES OF ANALYZER FUNCTION

During a real time measurement (in ANALYZER function), if the user presses the SAVE button, a "Smp" record will be generated in the "ANALYZER MEMORY". This file contains the Voltage and Current values present at the instrument input when the SAVE key was pressed.
Downloading these values to a PC (using the management software) the Power, Energy and Harmonics values can be calculated and displayed as well.

9. RECORDINGS

9.1. START A RECORDING

The recording function is available for the **ANALYZER** and **AUX** rotary switch positions. As detailed in the paragraphs 6.7.1 and 7.2, a recording can be started manually or automatically. Therefore, after setting all the parameters **and leaving the Menu**, the instrument will start to record:

- ✓ MANUALLY: the recording will start when the instrument's time reaches the "00" seconds value after pressing **START/STOP**.
- ✓ AUTOMATICALLY: **If the operator has pressed START/STOP** the instrument will remain in stand-by until the date and time set, then the recording will start.

WARNING

For recordings **we recommend the use of an optional external power supply adapter** (codeMARVR2250PSU) The instrument will however, perform a recording using internal batteries.

If you start recording without the external power supply adapter (code MARVR2250PSU) the instrument will display a warning message "**No ext supply**". Press **START** key again to run the recording, or press **ESC** to quit.

If during a recording the external power supply adapter (code MARVR2250PSU) is de-energised, the instrument will continue the recording using internal battery power until the batteries are exhausted (the data stored will be retained). We recommend you **ALWAYS insert a new set of batteries before a long recording**.

The instrument uses sophisticated algorithms to prolong the battery life. Particularly:

- ✓ The instrument switches the backlight OFF automatically after 5 seconds.
- ✓ If the battery level is too low the backlight function will be disabled.
- ✓ If the instrument is displaying in real time (and the external power supply is not connected), the instrument turns off automatically about 5 minutes from the last key press or switch rotation ("AUTOPOWER OFF" function).
- ✓ If the instrument is recording or is measuring energy (and the external power supply is not connected), after about 5 minutes from the last key press or switch rotation the instrument starts a procedure to save the batteries ("ECONOMY MODE"): the instrument keeps recording but the display is turned off.

Before starting a recording the operator should first evaluate the state of the equipment, decide what to record and set the instrument accordingly.

9.2. SETTING TYPICAL CONFIGURATIONS

In order to facilitate this task, the instrument is provided with the two pre-set recording modes:

1. **Default Configuration:** this is comprehensive and should fit most cases**.**
2. **Typical Configuration**: it is possible to select recording with pre-set parameters for the following situations:

EN50160	Setting parameters for Network Quality in compliance with EN 50160 standard
SURGES & DIPS	Setting parameters for Voltage Anomalies detection (surges, dips, break, etc.)
HARMONICS	Setting parameters for Harmonic Analysis of Voltage and Current
START-UP	Setting parameters for Start-Up - motors and electrical devices
POWER & ENERGY	Setting parameters for Power and Energy measurements

9.2.1. Default Configuration

The default configuration consists of the following parameter settings:

✓ ANALYZER CONFIG:

System:	SINGLE
Frequency:	50Hz
Current Range:	1000A
Clamp Type:	STD
TV Ratio:	0001
Password:	DISABLED

✓ RECORDER CONFIG:

Start:	MANU (the recording is started 1 minute after pressing the START/STOP key)
Stop:	MANU
Integration period:	15min
Recording of harmonics:	ON
Recording of Voltage anomalies (voltage Sag and Surge) :	ON
Voltage Reference for Sag and Surge detection:	230V
Upper Limit for Sag and Surge detection:	6%
Lower Limit for Sag and Surge detection:	10%
Selected voltages:	V1
Selected voltage harmonics:	THD, 01, 03, 05, 07
Selected currents:	I1
Selected current harmonics:	THD, 01, 03, 05, 07
CO-GENERATION:	OFF
Powers, Pf and cosφ selected:	P1
	Q1i
	Q1c
	S1
	Pf1
	DPF1
Energies:	Ea1
	Eri1
	Erc1

If the user changes the instrument settings, the user can quickly restore the above configuration using the **RESET** option (see paragraph 5.4).

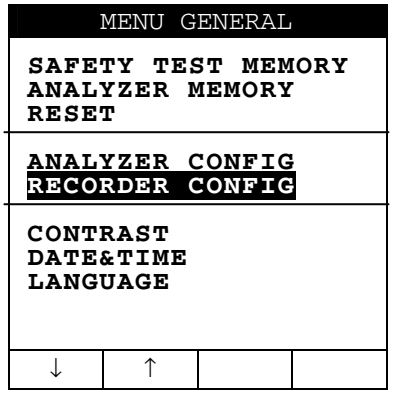
By pressing **START/STOP** the recording of the selected parameters is started according to the settings made in the MENU (see paragraphs 7.1 and 7.2). The rotary switch position does not affect the recording setting.

As the default value of the integration periods is set at 15 minutes, the instrument will store data in the temporary memory for 15 minutes. Afterwards the instrument will elaborate the results saved in the temporary memory and will save the result (min, avg, and max values) to the definitive memory. Therefore, if an integration period of 15 minutes has been set, the recording will continue for about 15 minutes before producing a series of recorded values. If the recording is interrupted before the selected integration period has elapsed, the data stored in the temporary memory will not be elaborated and the corresponding series of values will not be transferred to the definitive memory.

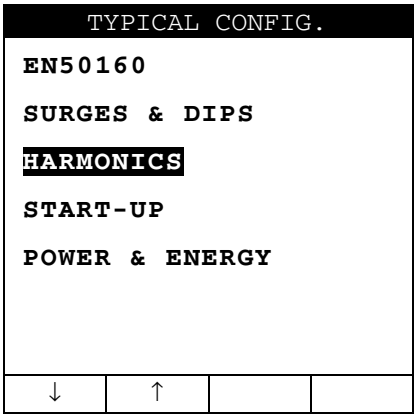
9.2.2. Typical Configurations

To activate the Typical Configurations, follow this procedure:

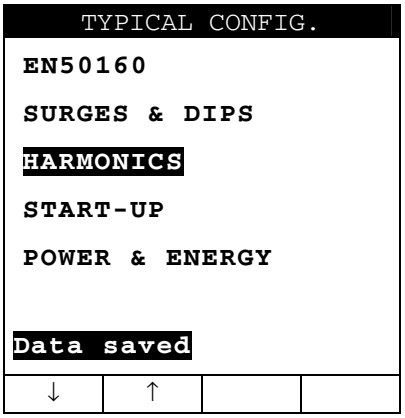
1. Turn the rotary switch to "**ANALYZER**".
2. Press **MENU** key followed by F1/F2 to navigate to the following screen:



3. Press **MENU** key again. The instrument displays a screen as shown below (picture on the left). This way it is possible to select the desired configuration with **F1** or **F2** key.



Configuration selection



Confirmation configuration selection

4. Press **ENTER** key. The instrument displays the message "**Data saved**" for a while to confirm the desired configuration (see above on the right). The instrument will return to the measure mode.

Below you can find the parameters for each of **5** Typical Configurations:

EN50160

✓ ANALYZER CONFIG:

System:	SINGLE
Frequency:	50Hz
Current Range:	not modified
Clamp Type:	STD
TV Ratio:	not modified
Password:	not modified

✓ RECORDER CONFIG:

Start:	MANU (the recording is started 1 minute after pressing the **START/STOP** key)
Stop:	MANU
Integration period:	10min
Recording of harmonics:	ON
Recording of Voltage anomalies (voltage Dips and Surge) :	ON
Voltage Reference for Dips and Surge detection:	230V
Upper Limit for Dips and Surge detection:	6%
Lower Limit for Dips and Surge detection:	10%
Selected voltages:	V1
Selected voltage harmonics:	THD, DC, 01, 02, 03, 04 … 25
CO-GENERATION:	OFF

SURGES & DIPS

✓ ANALYZER CONFIG:

System:	SINGLE
Frequency:	50Hz
Current Range:	not modified
Clamp Type:	STD
TV Ratio:	not modified
Password:	not modified

✓ RECORDER CONFIG:

Start:	MANU (the recording is started 1 minute after pressing the **START/STOP** key)
Stop:	MANU
Integration period:	1min
Recording of harmonics:	OFF
Recording of Voltage anomalies (voltage Dips and Surge) :	ON
Voltage Reference for Dips and Surge detection:	230V
Upper Limit for Dips and Surge detection:	6%
Lower Limit for Dips and Surge detection:	10%
Selected voltages:	V1
Selected current:	I1
CO-GENERATION:	OFF

HARMONICS

✓ ANALYZER CONFIG:

System:	SINGLE
Frequency:	50Hz

Current Range:	not modified
Clamp Type:	STD
TV Ratio:	not modified
Password:	not modified

✓ RECORDER CONFIG:

Start:	MANU (the recording is started 1 minute after pressing the **START/STOP** key)
Stop:	MANU
Integration period:	10min
Recording of harmonics:	ON
Recording of Voltage anomalies (voltage Dips and Surge) :	OFF
Selected voltages:	V1
Sel. Harmonics voltage :	THD,DC,01,03,05,07,09,11,13,15,17,19,21,23,25
Selected current:	I1
Sel. Harmonics current:	THD,DC,01,03,05,07,09,11,13,15,17,19,21,23,25
CO-GENERATION:	OFF

START-UP

✓ ANALYZER CONFIG:

System:	SINGLE
Frequency:	50Hz
Current Range:	not modified
Clamp Type:	STD
TV Ratio:	not modified
Password:	not modified

✓ RECORDER CONFIG:

Start:	MANU (the recording is started 1 minute after pressing the **START/STOP** key)
Stop:	MANU
Integration period:	5sec
Recording of harmonics:	ON
Recording of Voltage anomalies (voltage Dips and Surge) :	ON
Voltage Reference for Dips and Surge detection:	230V
Upper Limit for Dips and Surge detection:	6%
Lower Limit for Dips and Surge detection:	10%
Selected voltages:	V1
Selected voltage harmonics:	THD, 01, 03, 05, 07, 09, 11, 13, 15
Selected currents:	I1
Selected current harmonics:	THD, 01, 03, 05, 07, 09, 11, 13, 15
CO-GENERATION:	OFF
Powers, Pf and cosφ selected:	P1 Q1i Q1c S1 Pf1 dpf1
Energies:	Ea1 Eri1 Erc1

POWER & ENERGY

✓ ANALYZER CONFIG:

System:	SINGLE
Frequency:	50Hz
Current Range:	not modified
Clamp Type:	STD
TV Ratio:	not modified
Password:	not modified

✓ RECORDER CONFIG:

Start:	MANU (the recording is started 1 minute after pressing the **START/STOP** key)
Stop:	MANU
Integration period:	15min
Recording of harmonics:	OFF
Recording of Voltage anomalies (voltage Dips and Surge) :	OFF
Selected voltages:	V1
Selected currents:	I1
CO-GENERATION:	ON
Powers, Pf and cosφ selected:	P1
	Q1i
	Q1c
	S1
	Pf1
	dpf1
Energies:	Ea1
	Eri1
	Erc1

By pressing **START/STOP** the recording of the selected parameters is started according to the settings made for each Typical Configuration. The rotary switch position does not affect the recording setting.

9.3. DURING A RECORDING

If during a recording the external power supply is de-energised, the instrument will continue the recording using the internal battery power until the batteries are exhausted (the data stored up to the point the instrument shuts down will be saved). We recommend you **ALWAYS insert a new set of batteries before a long recording**.

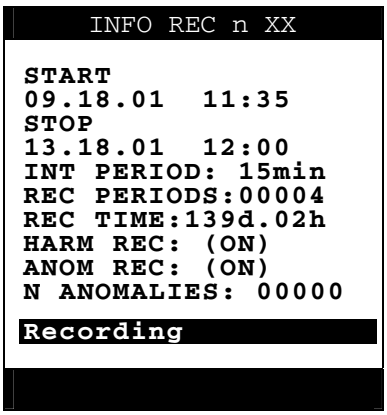
The instrument uses sophisticated algorithms to prolong the battery life. If the instrument is recording or is measuring energy (and the external power supply is not connected), about 5 minutes from the last key pressure or switch rotation the instrument starts a special procedure to save the batteries ("ECONOMY MODE"): the instrument keeps recording but the display is turned off.

During a recording the following are disabled:

- ✓ **AUTOPOWER OFF function**
- ✓ **ON/OFF key**
- ✓ **HOLD key**
- ✓ **SAVE key**

9.3.1. MENU key

If you press the **MENU** key during a recording a screen similar to this will appear:

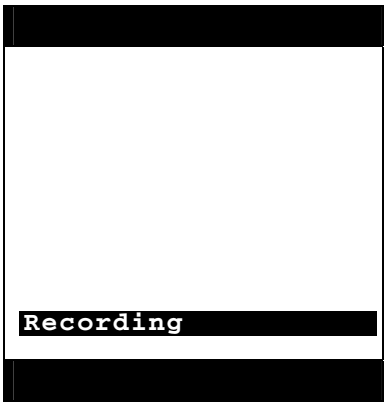


This screen includes:

1. START Date and Time
2. STOP Date and Time (or Manual).
3. Integration Period
4. Actual Number of Elapsed Integration Periods
5. Actual Recording Time
6. Status of Harmonic Flag
7. Status of Voltage Anomalies Flag
8. Number of Voltage anomalies occurred during the recording

9.3.2. Rotary Switch during a recording

If you move the rotary switch during a recording the following screen will appear:



This screen means that a recording is running. The instrument will continue to record.

9.4. STOPPING A RECORDING OR AN ENERGY MEASUREMENT

The instrument uses a protective routine to avoid interruption of a recording or an energy measurement. Once a recording or a direct energy measurement (see paragraph 7.7.2) has been started (with the PASSWORD option enabled), about 3 minutes from the last key pressure or switch rotation it is insufficient to press START/STOP (if a recording is running) or **F2** (if an energy measuring is running) to stop the recording, it will be necessary to enter the password.
In order to enter the password (which is not changeable), press the multifunction keys in the following sequence (within 10 seconds):

F1, **F4**, **F3**, **F2**

In order to enable/disable this option see paragraph 7.1.

If a wrong password is entered, the instrument will display an error message and will repeat the request.

If no key is pressed after about 10 seconds the instrument returns back to the original screen.

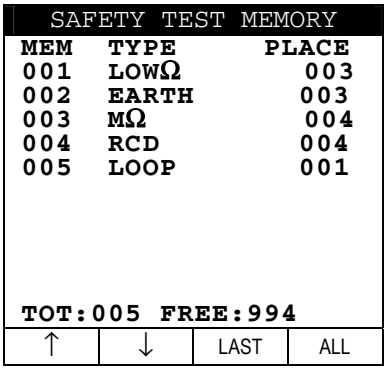
10. INSTRUMENT MEMORY

By pressing the **MENU** key the following screen will be displayed:

It is not possible to enter the **MENU** during a recording or a Real Time Energy measurement.

10.1. SAFETY TEST MEMORY

Selecting the SAFET TEST MEMORY item and pressing ENTER the instrument displays the following screen:



Example of SAFETY TEST MEMORY screen

- ✓ MEM: Order Number of the measurement
- ✓ TYPE: Measurement TYPE
- ✓ PLACE: Mnemonic parameter associated by the user to the measurement
- ✓ TOT: Total number of measurements
- ✓ FREE: Available memory locations

The following keys are enabled:

- ☞ **F1**, **F2**: to select the measurement.
- ☞ **F3**: to clear the last recording performed.
- ☞ **F4**: to clear all the recordings performed.
- ☞ **ENTER**: to see the results of the selected test
- ☞ **ESC**: to quit this mode

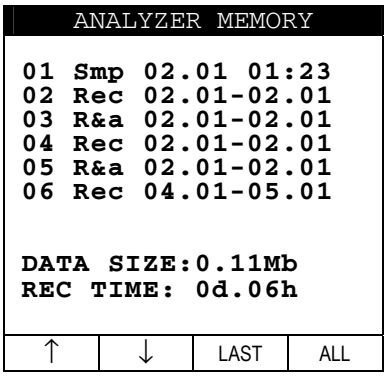
10.2. ANALYZER MEMORY

This option permits you to display:

- ✓ The contents of the instrument memory
- ✓ The size of the memorised data
- ✓ The space available for future recordings (expressed in days and hours)

The stored data can be displayed and analysed only by downloading the data to a PC with the operating software.

After selecting "ANALYZER MEMORY" from the Main Menu the screen below will be displayed



Example of ANALYZER MEMORY screen

- ✓ Rec: **recordings** with respective Start and Stop dates expressed in the format "day. month" (start) – "day. month" (stop) ***without*** Voltage Sag and Surge detection.
- ✓ R&a: **recordings** with respective Start and Stop dates expressed in the format "day. month" (start) – "day. month" (stop) ***with*** Voltage Anomalies (Sag and Surge) detection.
- ✓ Smp: values of the **samples** of voltage and current stored by pressing SAVE.
- ✓ DATA SIZE: dimensions of the data saved in the instrument memory.
- ✓ REC TIME: amount of memory available, calculated on the basis of the parameters selected for recording

The maximum quantity of Rec + R&a + Smp which can be stored by the instrument is **35.**

The following keys are enabled:

- ☞ **F1**, **F2**: if the number of Rec+R&a+Smp recordings is higher than 7, use these keys to select recordings stored in the instrument memory.
- ☞ **F3**: to cancel the last recording performed.
- ☞ **F4**: to cancel all the recordings performed.
- ☞ **ESC**: to quit this mode

11. CONNECTING THE INSTRUMENT TO A PC

In order to connect the instrument to a PC you must connect the optical serial cable that is shipped with the instrument to a PC COM port.

The available transmission speeds are the following:

9600, 19200, 57600 (default value)

The value of the transmission speed (Baud Rate) is displayed on the initial screen (immediately after turning on the instrument, see paragraph 4.2). The value of this parameter can be modified only with the management software.

For download instructions please refer to software help file.

In order to transfer the memorised data from the instrument to the PC the following procedure must be followed (after software installation):

1. **Switch ON the instrument and wait until the initial screen disappears (the rotary switch position is not relevant).**
2. **Connect the optical serial output of the instrument to the serial output of the PC through the original optical serial cable.**
3. **Run the program**
4. **Select the "Download" command**
5. **Refer to software help ON Line for further instructions.**

12. MAINTENANCE

12.1. GENERAL INSTRUCTIONS

The tester you have purchased is a precision instrument. Please follow the instructions for use and storage detailed in this manual to avoid any possible damage or danger during use.
Do not use this tester under unfavourable conditions of high temperature or humidity. Do not expose to direct sunlight.
Be sure to turn the tester off after use. If the instrument is not to be used for a long period you are recommended to remove batteries to avoid acid leakage which may damage the internal circuits of the instrument.

12.2. BATTERY REPLACEMENT

The symbol shows the battery charge: If it is completely "black" the batteries are fully charged, while the symbol indicates flat batteries. When the batteries are too low to execute the test, the instrument will show a warning message.
Replace the batteries, following the procedure for battery replacement.

The instrument is capable of keeping the data stored even though batteries are not installed. The instrument Date and Time settings are not lost if you change the batteries within 24 hours.

⚠ **CAUTION:** Before replacing batteries make sure that all test leads have been **disconnected** from input terminals.

1. Switch OFF the instrument.
2. Remove all the test leads from the input terminals.
3. Unscrew the fixing screw from the battery compartment and remove cover.
4. Remove all batteries replacing them with 6 new ones of the same type (1.5V – LR6 – AA – AM3 – MN 1500) respecting the polarity signs.
5. Refit the battery compartment cover.

12.3. INSTRUMENT CLEANING

Use a soft dry cloth to clean the instrument. Never use wet cloths, solvents, water, etc.

12.4. END OF LIFE

Caution: this symbol indicates that equipment and its accessories shall be subject to a separate collection and correct disposal

13. TECHNICAL SPECIFICATIONS

13.1. TECHNICAL FEATURES

Accuracy is indicated as [% of reading + number of digits]. It refers to the following atmospheric conditions: a temperature of 23°C ± 5°C with a relative humidity < 60%.

Martindale Electric Ltd reserves the right to change specification without notice, and without incurring any obligation.

Safety Test functions

- **LOWΩ: 200mA CONTINUITY TEST (AUTO, RT+, RT- MODE)**

Range [Ω]	Resolution [Ω]	Accuracy(*)
0.01 - 9.99 10.0 - 99.9	0.01 0.1	±(2% Reading + 2 digits)

(*) After Test leads calibration

Test Current > 200mA DC per R≤5Ω (Test leads included)
Resolution for Test current: 1mA
Open Circuit Voltage V0 ≥ 4V ≤ 24V

- **MΩ: INSULATION TEST**

Test Voltage [V]	Range [MΩ]	Resolution [MΩ]	Accuracy
50	0.01 - 9.99	0.01	±(2% Reading + 2 digits) if V/R>1µA
	10.0 - 49.9	0.1	
	50.0 - 99.9	0.1	±(5% Reading + 2 digits) if V/R≤1µA
100	0.01 - 9.99	0.01	±(2% Reading + 2 digits) if V/R>1µA
	10.0 - 99.9	0.1	
	100.0 - 199.9	0.1	±(5% Reading + 2 digits) if V/R≤1µA
250	0.01 - 9.99	0.01	±(2% Reading + 2 digits) if V/R>1µA
	10.0 - 199.9	0.1	
	200 - 249	1	
	250 - 499	1	±(5% Reading + 2 digits) if V/R≤1µA
500	0.01 - 9.99	0.01	±(2% Reading + 2 digits) if V/R>1µA
	10.0 - 199.9	0.1	
	200 - 499	1	
	500 - 999	1	±(5% Reading + 2 digits) if V/R≤1µA
1000	0.01 - 9.99	0.01	±(2% Reading + 2 digits) if V/R>1µA
	10.0 - 199.9	0.1	
	200 - 999	1	
	1000 - 1999	1	±(5% Reading + 2 digits) if V/R≤1µA

Open circuit Test Voltage <1.3 x Nominal Test Voltage
Short Circuit Current <6.0mA with 500V Test Voltage
Nominal Test Current 500V >2.2mA with 230kΩ
other >1mA with 1kΩ*Vnom

- **RCD: TEST ON RCD DEVICES**

Nominal Test Current (IΔN) 10mA, 30mA, 100mA, 300mA, 500mA
RCD type AC, A General and Selective
Phase to Earth Test Voltage 100V - 250V 50 Hz
Frequency 50Hz ± 0.5Hz

- Tripping Time Measurement $t_{\Delta N}$

Range [ms]		Resolution [ms]	Accuracy
½ $I_{\Delta N}$, $I_{\Delta N}$	1 - 999	1	±(2%Reading + 2digits)
2 $I_{\Delta N}$	1 - 200 general		
	1 - 250 selective		
5 $I_{\Delta N}$ RCD	1 - 50 general		
	1 - 160 selective		

- Contact Voltage Ut

Range [V]	Resolution [V]	Accuracy
0 - $2U_{t\,lim}$	0.1	- 0%, +(5% Reading + 3 digits)

Ut LIM (UL): 25V or 50V

- Global Earth Resistance Measurement (avoiding RCD tripping)

Range [Ω]	Resolution [Ω]	Accuracy IΔN
1 - 1999	1	- 0%, +(5% Reading + 3 digits)

Test Current 0.5 IΔN set

- Tripping Current Measurement

IΔN	RCD Type	Range $I_{\Delta N}$ [mA]	Resolution [mA]	Accuracy IΔN
IΔN ≤ 10mA	AC	(0.5 - 1.4) $I_{\Delta N}$	0.1 $I_{\Delta N}$	- 0%, +5% $I_{\Delta N}$
	A	(0.5 - 2.4) $I_{\Delta N}$		
IΔN > 10mA	AC	(0.5 - 1.4) $I_{\Delta N}$		
	A	(0.5 - 2) $I_{\Delta N}$		

- **FREQUENCY MEASUREMENT**

Range [Hz]	Resolution [Hz]	Accuracy
47.0 - 63.6	0.1	±(0.1%Reading + 1 digit)

RCD and LOOP function are active only for 50Hz ± 0,5Hz frequency

- **VOLTAGE MEASUREMENT (RCD, LOOP, PHASE ROTATION)**

Range [V]	Resolution [V]	Accuracy
0 - 460V	1	±(3%Reading + 2 digits)

- **LOOP P-P, P-N: LINE IMPEDANCE MEASUREMENT (Phase - Phase, Phase - Neutral)**

Range [Ω]	Resolution [Ω]*	Accuracy
0.01 - 9.99 10.0 - 199.9	0.01 0.1	±(5% Reading + 3 digits)

(*) 0.1 mΩ on range 0.0 - 199.9 mΩ (with IMP57)

Peak value of the Test current	127V 3.65A 230V 6.64A 400V 11.5A
Voltage Range (Phase - Phase, Phase - Neutral)	100 - 250/ 100 - 440V
Frequency	50Hz ± 0.5Hz

- **LOOP P-PE: FAULT LOOP IMPEDANCE MEASUREMENT (Phase - Earth)**

Range [Ω]	Resolution [Ω]*	Accuracy
0.01 - 19.99 20.0 - 199.9 200 - 1999	0.01 0.1 1	±(5% Reading + 3 digits)

(*) 0.1 mΩ on range 0.0 - 199.9 mΩ (with IMP57)

Peak value of the Test current:	127V 3.65A 230V 6.64A
Voltage Range (Phase - Earth)	100 - 250V
Frequency	50Hz ± 0.5Hz

- **LOOP $R_{a\ 15mA}$: FAULT LOOP IMPEDANCE MEASUREMENT without RCD Tripping (Phase - Earth)**

Range [Ω]	Resolution [Ω]	Accuracy
1 ÷ 1999	1	- 0%, +(5% Reading + 3 digits)

Test Current	15mA
Voltage Range (Phase - Earth)	100 - 250V 50Hz

- **EARTH: GROUND RESISTANCE MEASUREMENT WITH EARTH RODS**

Range RE [Ω]	Resolution [Ω]	Accuracy
0.01 - 19.99 20.0 - 199.9 200 - 1999	0.01 0.1 1	±(5% Reading + 3 digits)

Test Current	<10mA - 77.5Hz
Open circuit Test Voltage	<20V RMS

- **RESISTIVITY MEASUREMENT**

Range ρ	Resolution	Accuracy
0.60 -19.99 Ωm 20.0 - 199.9Ωm 200 - 1999Ωm 2.00 - 99.99kΩm 100.0 - 125.6kΩm(*)	0.01 Ωm 0.1Ωm 1 Ωm 0.01 kΩm 0.1 kΩm	±(5% Reading + 3 digits)

(*) setting distance = 10m

Test Current	<10mA – 77.5Hz
Open circuit Test Voltage	<20V RMS

13.1.1. ANALYZER and AUX functions

- **VOLTAGE MEASUREMENT – SINGLE PHASE SYSTEM (AUTORANGE)**

Range [V]	Resolution [V]	Accuracy	Input Impedance
15 - 310V	0.2V	±(0.5% Reading+2digits)	300kΩ (Phase - Neutral) 300kΩ (Phase - Phase)
310 - 600V	0.4V		

- **VOLTAGE SAG AND SURGE DETECTION – SINGLE PHASE SYSTEM (MANUAL RANGE)**

Range [V]	Resolution (Voltage)	Resolution (Time)	Accuracy (Voltage)	Accuracy (rif. 50Hz) (Time)	Input Impedance
15 - 310V	0.2V	10ms (½ period)	±(1.0% Reading+2digits)	± 10ms (½ period)	300kΩ (Phase - Neutral) 300kΩ (Phase - Phase)
310 - 600V	0.4V				

- **CURRENT MEASUREMENT – SINGLE PHASE SYSTEM (AUTORANGE)**

Range [V]	Resolution [mV]	Accuracy	Input Impedance	**Overload** Protection
0.005 - 0.26V	0.1	±(0.5% Reading+2digits)	200kΩ	5V
0.26 - 1V	0.4			

(*): Example: with a 1000A/1V full scale clamp , the instrument detect only current higher than 5A

- **POWER MEASUREMENT – SINGLE PHASE SYSTEM (AUTORANGE)**

Quantity	Range	Resolution	Accuracy
ACTIVE POWER	0 - 999.9W 1 - 999.9kW 1 - 999.9MW 1000 - 9999MW	0.1W 0.1kW 0.1MW 1MW	±(1.0% Reading + 2 digits)
REACTIVE POWER	0 - 999.9VAR 1 - 999.9kVAR 1 - 999.9MVAR 1000 - 9999MVAR	0.1VAR 0.1kVAR 0.1MVAR 1MVAR	
APPARENT POWER	0 - 999.9VA, 1 - 999.9kVA, 1 - 999.9MVA 1000 - 9999MVA	0.1VA 0.1kVA 0.1MVA 1MVA	
ACTIVE ENERGY (Class 2 EN61036)	0 - 999.9Wh, 1 - 999.9kWh, 1 - 999.9MWh 1000 - 9999MWh	0.1Wh 0.1kWh 0.1MWh 1MWh	
REACTIVE ENERGY (Class 3 IEC1268)	0 - 999.9VARh, 1 - 999.9kVARh, 1 - 999.9MVARh 1000 - 9999MVARh	0.1VARh 0.1kVARh 0.1MVARh 1MVARh	

- **Cos φ MEASUREMENT – SINGLE PHASE SYSTEM**

Cos φ	Resolution	Accuracy [°]
0.20	0.01	0.6
0.50		0.7
0.80		1.0

- **VOLTAGE AND CURRENT HARMONICS MEASUREMENT – SINGLE PHASE SYSTEM**

Range	Resolution	Accuracy
DC – 25H	0.1V / 0.1A	±(5% + 2 digits)
26H – 33H		±(10% + 2 digits)
34H – 49H		±(15% + 2 digits)

Harmonics values are null under fixed threshold:

- DC: its values are null if it is < 2%of Fundamental or is <2% of Full Scale clamp
- 1st Current Harmonic: its values are null if it is < 0.2% Full Scale clamp
- 2nd - 49th : its values are null if it is < 2% of fundamental or is <2% of Full Scale clamp

- **LEAKAGE CURRENT MEASUREMENT**

Range (*)	Resolution [mA]	Accuracy	Input Impedance	Overload Protection
0.5 - 999.9mA	0.1mA	±(5% Reading + 2digits)	200kΩ	5V

(*): During a recording the instrument will detect only Current > 5mA with Resolution 1mA

13.2. STANDARDS

13.2.1. General

Safety	EN 61010-1 + A2 (1997)
Protection classification	Class 2 - Double Insulation
Pollution degree	2
Degree of Protection:	IP50
Over-Voltage Category	CAT II 600V~ / 350V~ (phase –earth) CAT III 600V~ / 300V~ (phase –earth)
Usage:	Indoor; max height 2000m
EMC	EN61326-1 (1997) + A1 (1998)

The instrument complies with European Guidelines for CE mark

13.2.2. Safety Test

LOWΩ (200mA):	IEC 61557-4
MΩ:	IEC 61557-2
RCD:	IEC 61557-6
LOOP P-P, P-N, P-PE:	IEC 61557-3
PHASE SEQUENCE:	IEC 61557-7
EARTH:	IEC 61557-5

13.2.3. ANALYZER

Voltage Sag and Surge	EN50160
Alternating Current Static Watt-hour meters for Active Energy	EN61036 (CLASS 2)
Alternating Current Static VAR-hour meters for Reactive Energy	IEC1268 (CLASS 3)

13.3. GENERAL SPECIFICATIONS

13.3.1. Mechanical Data

Dimensions	225 (L) x165 (W) x 105 (H) mm
Weight	1295g approx (including batteries) 1150g approx (excluding batteries)

13.3.2. Power supply

Batteries	6 x 1.5-LR6-AA-AM3-MN 1500	
Battery Life:	LOWΩ:	approx: 800 tests
	MΩ:	approx: 500 tests
	RCD AC and A Type:	approx: 1000 tests
	LOOP P-P, P-N, P-PE	approx: 1000 tests
	Ra⏚:	approx: 1000 tests
	EARTH:	approx: 1000 tests
	PHASE SEQUENCE:	approx: 1000 tests
	AUX (recording):	approx: 20 Hours
	ANALYZER (recording):	approx: 20 Hours
External Power Supply Adapter (optional)	Code MARVR2250PSU (for ANALYZER and AUX) functions	

13.3.3. Display

Display Type	Graphic with backlight
Resolution	128 x128
Visible Area	73mm x 73mm

13.3.4. Memory

Safety Test Memory	999 measurements
ANALYZER:	2MByte (with 63 channels selected and Integration Period = 15min), more than 30 days).

13.4. ENVIRONMENT

Reference Temperature	23° ± 5°C
Working Temperature Range	0° - 40°C
Working Humidity	< 80%
Storage Humidity Range	-10° - + 60°C
Storage Humidity	< 80%

13.5. ACCESSORIES

Standard accessories
Description

- GB 13A cable with 3 terminals
- Set with 4 cables (2m), 4 croc clips,
- Management Software + RS232 Optical-Serial Cable
- Zip Carrying Case
- Calibration Certificate ISO9000
- User's Manual

Optional Accessories

Description	Code
• Set with 4 cables and 4 earth rods	MARER4KIT
• External power supply adaptor	MAR2250PSU
• Flexible current clamp 1000A / 3000A	

14. SERVICE

14.1. WARRANTY

Faults in manufacture and materials are fully guaranteed for 24 months from date of invoice and will be rectified by us free of charge, provided that the unit has not been tampered with and is returned to us with its housing unopened. Damage due to dropping, abuse or misuse is not covered by the guarantee. Nothing in these instructions reduces your statutory rights.

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NOTE: The manufacturer reserves the right to modify the product specifications and prices if this is aimed at technological improvements

The content of this manual cannot be reproduced in any form whatsoever without prior authorisation of the manufacturer.

14.2. SERVICE

Repair & Service

There are no user serviceable parts inside this unit. Please return to Martindale Electric Company Ltd if faulty, unless fuse replacement only is necessary. Our service department will promptly quote to repair any faults that occur outside the warranty period. Please call our service and calibration department on **01923 650620** for further details.

15. APPENDIX 1 – MESSAGES DISPLAYED

Message	Description	Advices
AUTONOM:	Available memory for recording	
CLEAR ALL? (Enter)	The operator is trying to cancel all the recordings	Press ESC in order not to cancel the whole memory, press ENTER to confirm
CLEAR LAST? (Enter)	The operator is trying to cancel the last recording	Press ESC in order not to cancel the last recording, press ENTER to confirm
Data saved	The data has been saved	
DATA SIZE:	Dimensions of the stored data	
HOLD	The HOLD function has been activated	Press HOLD again to disable this function
Password:	A recording has been started and at least 5 minutes have passed from the last activity of the instrument (see paragraph 7).	Insert the password: **F1, F4, F3, F2**
Invalid date	The date entered is not correct	Check the date entered
Energy Measuring	The instrument is taking an energy measurement	Press F1 to stop
Memory Full	The instrument memory is full	Cancel some recordings after transferring them to a PC
No ext supply!	A recording has been started without connecting the external power supply (code MARVR2250PSU)	Verify if you really want to start the recording without the external power supply. In that case press START again.
No parameter sel	A recording has been started without selecting any value to be recorded	Press START/STOP and select at least a value entering the MENU
No Phase selected	Voltage and / or current harmonics have been selected and the corresponding flag has been enabled (HARMONICS ON) but no phase voltage or current has been selected	Select at least one phase voltage and / or current
PASSWORD ERROR	The password entered is wrong (see paragraph 8.1.6).	Check the password
PASSWORD OK	The password entered is correct	
Please wait	The instrument is waiting for the recording to be started (see paragraph 10)	
Recording	The instrument is recording (see paragraph 10)	
Too many param	More than 63 parameters have been selected (harmonics included) or More than 38 parameters with CO-GENERATION Flag enabled	Deselect some values
Too many records	The quantity of recorded data + Smp exceeds the maximum allowed (35)	Cancel some recordings after transferring them to a PC
No Unit selected		
ERR: SEQ	The Phase Sequence is not correct.	Check the Phase Sequence connection.
ERR: P-	The active powers shown on the right of the message are negative	If there is not a situation of co-generation, check if the clamps are properly connected
ERR: SEQ & P-	The active powers shown on the right of the message are negative and the Phase Sequence is not correct.	If there is not a situation of co-generation check if the clamps are properly connected / check the Phase Sequence connection.
ERR: CONNECTION	The instrument has detected a wrong connection to voltage inputs	Check the voltage connections
Error Vref	The user set a voltage reference not compatible with voltage at instrument's input.	Check Voltage Reference set in "CONFIG RECORDER"
ERR: SYNC	The System Frequency is out of range	Check the System Frequency, check setting in ANALYZER CONFIG.
Selection Error	There is a mismatch between the parameter enabled and the parameter selected for an AUX recording.	Check the parameter enabled in AUX position and the selected parameter for recording.
Error1 - Error 5	The instrument memory is damaged.	Contact Martindale Electric

16. APPENDIX 2 – RECORDABLE PARAMETERS: SYMBOLS

Symbol	Description
V1	Voltage RMS value
freq	Network frequency
I1	Current RMS value
DC	Continuous component of voltage or current
h01 - h49	Harmonic 01 - Harmonic 49 of voltage or current
ThdV	Factor of total harmonic distortion of the voltage
ThdI	Factor of total harmonic distortion of the current
P1	Active power
Q1i	Inductive Reactive power
Q1c	Capacitive Reactive power
S1	Apparent power
pf1	Power factor
dpf1	cosφ
Ea1	Active energy
Eri1	Inductive reactive Energy
Erc1	Capacitive reactive Energy